Specifications of the South African hake 2019 Reference Case assessment[1]

Rebecca A. Rademeyer, Doug S. Butterworth and A. Ross-Gillespie[2]

Summary

This document provides the detailed and comprehensive specifications for the 2019 Reference Case assessment model for the South African hake resource, including the algebraic specifications for the assessment model, tables listing the input data and key assessment results for the Reference Case. Note that the RC results presented here do not correspond to the most recent assessment results (as the specification document has not been updated since the last assessment update). Results for the most recent update for the 2019 RC can be viewed in FISHERIES/2019/OCT/SWG-DEM/22rev.

Introduction

This paper gives full algebraic specifications of the 2019 South African hake Reference Case assessment. The data used as input to the Reference Case are listed in Appendix A. Parameter estimates and detailed values for different contributions to the negative log-likelihood are also included. The Reference Case results are given in Appendix B.

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[1] This document is an update of MARAM/IWS/2018/Hake/P1rev, which provided the specifications for the 2018 Reference Case (RC) assessment model. The changes are largely a consequence of recommendations made by the Panel for the 2018 International Stock Assessment workshop and consist of the following.

1. Given that the von Bertlanffy growth curves for the SA hake were consistently estimated as straight lines, the growth curves were reparameterized to curves consisting of two straight lines (i.e. piecewise linear curves): the first component a straight line from age zero to age 9, the second a straight line from age 9 onwards, the gradient of which is half the gradient of the first line. The two-line approach was taken as there is qualitative evidence in the age-length key data that growth slows at older ages, but the assessment model is unable to estimate this slowed growth, likely owing to the influence of outlier data points. As such the decision was made to force a two-line growth curve, with the gradient of the second being half of the first. A posfun function is used to prevent the growth curves taking on negative values; a value of 3cm is input into the posfun, which effectively ensures that the model-estimated size of zero-year old hake is not smaller than roughly one and a half centimetres.
2. The Baranov formulation for the catch equation has been implemented in place of Pope's approximation, and the fishing mortality values are estimated using the Hybrid method (see Appendix C).
3. In addition to the above, a further modification was made to the Ricker models to address the fact the *B0* parameter (i.e. the standard deviation for the length-at-age distribution of zero-year-old hake) for *M. paradoxus* females was being estimated at the lower bound of 0.1. The reason for this is that the Ricker models estimate the *M. paradoxus* zero-year-olds to be very small and the standard deviation for the age-length distributions is calculated by dividing the *B0* parameter by the mean length-at-age; thus the *B0* parameter is estimated as small as possible to prevent that quotient from becoming too large. Since there are very few age-length-key data for *M. paradoxus* zero-year-olds (17 data points for *M. paradoxus* compared to 133 data points for *M. capensis*), the *B0*/mean-length quotients estimated for *M. capensis* males and females have been used respectively for *M. paradoxus* males and females. The Beverton-Holt models do not have this problem, as the size of the small M. paradoxus fish is estimated to be larger for these models, and the *B0* parameter was thus estimated for each species and gender.
4. A coding glitch was detected that effectively resulted in data corresponding to juvenile (i.e. <20cm) fish being excluded from the age-length key negative log-likelihood calculations. The correction of this error made very little difference to the overall results, but is responsible for the increase in the negative log-likelihood component for the age-length key data increasing from about 124 to 130 points.

The changes under item 4, as well as the 3cm posfun penalty enforced on the zero-year-old hake (item 1), are the main reasons for the differences between the Reference Case results presented here and those presented in FISHERIES/2019/MAR/SWG-DEM/03.

[2] Marine Resource Assessment and Management Group, Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 77011.

The Statistical Catch-at-Length model

The model used is a gender-disaggregated Statistical Catch-at-Length (SCAL), which is fitted directly to age-length keys (ALKs) and length frequencies. The model also assesses the two species as two independent stocks and is fitted to species-disaggregated data as well as species-combined data. A distinction is made between the west and the south coasts, with hake movement surrogated using the “areas-as-fleets” approach. "Fleet" below therefore refers to a combination of gear type (offshore trawl, inshore trawl, longline and handline) and area (west and south coasts). The general specifications and equations of the overall model are set out below, together with some key choices in the implementation of the methodology. Details of the contributions to the log-likelihood function from the different data considered are also given. Quasi-Newton minimisation is used to minimise the total negative log-likelihood function (implemented using AD Model Builder™, Otter Research, Ltd. (Fournier *et al*. 2011)).

1 Population Dynamics

1.1 Numbers-at-age

The resource dynamics of the two populations (*Merluccius capensis* and *M. paradoxus*) of the South African hake are modelled by the following set of equations.

Note: for ease of reading, the ‘species’ subscript *s* has been omitted below where equations are identical for the two species.

$$N^g_{y+1,0} = R^g_{y+1} \tag{1}$$

$$N^g_{y+1,a+1} = N^g_{y,a} e^{-Z^g_{y,a}} \qquad \text{for } 0 \le a \le m-2 \tag{2}$$

$$N^g_{y+1,m} = N^g_{y,m-1} e^{-Z^g_{y,m-1}} + N^g_{y,m} e^{-Z^g_{y,m}} \tag{3}$$

where

N^g_{ya} is the number of fish of gender *g* and age *a* at the start of year *y*[3];

R^g_y is the recruitment (number of 0-year-old fish) of fish of gender *g* at the start of year *y*;

m is the maximum age considered (taken to be a plus-group);

$Z^g_{y,a} = M^g_a + \sum_f S^g_{f,y,a} F^g_{y,f}$ denotes the total mortality rate on fish of gender *g* and age *a*; where

M^g_a denotes the natural mortality rate on fish of gender *g* and age *a*;

$S^g_{f,y,a}$ is the commercial selectivity of gender *g* at age *a* for fleet *f* and year *y*; and

$F^g_{f,y}$ is the fished proportion of a fully selected age class by fleet *f* in year *y* (see Equation 8).

1.2 Recruitment

The number of recruits (i.e. new zero-year old fish) at the start of year *y* is assumed to be related to the corresponding female spawning stock size (i.e., the biomass of mature female fish). The underlying assumptions are that female spawning output can limit subsequent recruitment, but that there are always sufficient males to provide adequate fertilisation. The recruitment and corresponding female spawning stock size are related by means of the Beverton-Holt (Beverton and Holt 1957) or a modified (generalised) form of the Ricker stock-recruitment relationship. These forms are parameterized in terms of the “steepness” of the stock-recruitment relationship, *h*, the pre-exploitation equilibrium female spawning biomass, $K^{\text{♀},sp}$, and the pre-exploitation recruitment, R_0 ,with a 50:50 sex-split at recruitment being assumed:

$$R^g_y = \frac{4hR_0 B^{\text{♀},sp}_y}{K^{\text{♀},sp}(1-h) + (5h-1)B^{\text{♀},sp}_y} e^{(\varsigma_y - \sigma_R^2/2)} \tag{4a}$$

for the Beverton-Holt stock-recruitment relationship and

$$R^g_y = \alpha B^{\text{♀},sp}_y \exp\left(-\beta\left(B^{\text{♀},sp}_y\right)^\gamma\right) e^{(\varsigma_y - \sigma_R^2/2)} \tag{4b}$$

with

[3]In the interests of less cumbersome notation, subscripts have been separated by commas only when this is necessary for clarity.

$$\alpha = R_0 \exp\left(\beta\left(K^{♀,sp}\right)^{\gamma}\right)/ K^{♀,sp} \qquad \text{and} \qquad \beta = \frac{\ln(5h)}{\left(K^{♀,sp}\right)^{\gamma}\left(1-5^{-\gamma}\right)}$$

for the modified Ricker relationship (for the true Ricker, γ=1) where

ς_y reflects fluctuation about the expected recruitment in year y;

σ_R is the standard deviation of the log-residuals, which is input ($\sigma_R = 0.45$ and is taken to decrease linearly from this value to 0.1 over the last five years to statistically stabilise estimates of recent recruitment).

Note: $e^{(\varsigma_y - \sigma_R^2/2)}$ is included only for the years for which the residuals are estimated, i.e. 1985 to 2016.

$B_y^{♀,sp}$ is the female spawning biomass at the start of year y, computed as:

$$B_y^{♀,sp} = \sum_{a=1}^{m} f_a^{♀} w_a^{♀} N_{ya}^{♀} \tag{5}$$

where

w_a^g is the begin-year mass of fish of gender g and age a;

f_a^g is the proportion of fish of gender g and age a that are mature (converted from maturity-at-length, see equation 46); and

$$R_0 = K^{♀,sp} / \left[\sum_{a=0}^{m-1} f_a^{♀} w_a^{♀} e^{-\sum_{a'=0}^{a-1} M_{a'}^{g}} + f_m^{♀} w_m^{♀} \frac{e^{-\sum_{a'=0}^{m-1} M_{a'}^{g}}}{1-e^{-M_m^g}} \right] \tag{6}$$

For the Beverton-Holt form, h is bounded above by 0.98 to preclude high recruitment at extremely low spawning biomass, whereas for the modified Ricker form, h is bounded above by 2.0 to preclude extreme compensatory behaviour. The Reference Case uses the modified Ricker form to model recruitment.

1.3 Total catch and catches-at-age

The fleet-disaggregated catch by mass, in year y is given by:

$$C_{fy} = \sum_g \sum_{a=0}^{m} \widetilde{w}_{fy,a+1/2}^{g} \; C_{fya}^{g} = \sum_g \sum_{a=0}^{m} \widetilde{w}_{fy,a+1/2}^{g} \; F_{fy} S_{fya}^{g} N_{ya}^{g} \frac{1-e^{-Z_{y,a}^{g}}}{Z_{y,a}^{g}} \tag{7}$$

where C_{fya}^{g} is the catch-at-age, i.e. the number of fish of gender g and age a, caught in year y by fleet f.

F_{fy} is independent of g for all fleet except the longline fleet, for which male proportions are available. Therefore for the longline fleet, values for F_{fy}^{g} are found (using the Hybrid method) so that $C_{fy}^{g} = L_{fy}^{g} C_{fy}$, with L_{fy}^{males} given in Table 1 below.

Table 1: Male proportion in the longline catches. For years prior to 2000 and post 2010, the 2000-2010 average is used.

	West coast		South coast	
	M. paradoxus	*M. capensis*	*M. paradoxus*	*M. capensis*
2000	0.35699	0.09755	0.46030	0.29340
2001	0.05378	0.13431	0.52645	0.38234
2002	0.26296	0.13852	0.46030	0.36548
2003	0.22694	0.22288	0.46030	0.31665
2004	0.12542	0.10752	0.46030	0.26581
2005	0.05788	0.14946	0.46030	0.16476
2006	0.04562	0.10308	0.28792	0.27210
2007	0.03721	0.34383	0.46030	0.29340
2008	0.22329	0.29265	0.34573	0.27928
2009	0.22402	0.33734	0.61493	0.21179
2010	0.05378	0.13431	0.52645	0.38234

Note: given the implementation of the Baranov formulation of the catch equation, a penalty is added to the negative log-likelihood to ensure that the model-estimated catches match the observed catches to a reasonable degree of accuracy. This penalty takes the form $pen = \sum_{f,y}\left(ln\hat{C}_{f,y} - lnC_{f,y}^{obs}\right)^2/(2\sigma^2)$, with $\sigma = 0.02$ allowing for a roughly 5% CV in the variation of the model-predicted catches about the observed values.

$$S_{fya}^{g} = \sum_{l} S_{fyl}^{g} P_{a+1/2,l}^{g} \tag{9}$$

S_{fya}^{g} is the commercial selectivity of gender g at age a for fleet f and year y;

S_{fyl}^{g} is the commercial selectivity of gender g at length l for year y, and fleet f, normalised to have a maximum of 1;

$$\tilde{w}_{fy,a+1/2}^{g} = \sum_{l} S_{fyl}^{g} w_l^g P_{a+1/2,l}^{g} \Big/ \sum_{l} S_{fyl}^{g} P_{a+1/2,l}^{g} \tag{10}$$

$\tilde{w}_{fy,a+1/2}^{g}$ is the selectivity-weighted mid-year weight-at-age a of gender g for fleet f and year y;

w_l^g is the weight of fish of gender g and length l;

$P_{a+1/2,l}^{g}$ is the mid-year proportion of fish of age a and gender g that fall in the length group l (thus $\sum_{l} P_{a+1/2,l}^{g} = 1$ for all ages a).

The matrix P is calculated under the assumption that length-at-age is log-normally distributed about a mean, $\bar{L}_a$, given by a two-segment straight line growth curve[4], where growth is linear up to age 9 (with length at age 2 and 4 years being estimable parameters), after which the slope of the growth curve is reduced by a factor of 2. The length-at-age distribution is then given by:

$$ln\, l_a \sim N\left[ln(\bar{L}_a)\, ; \left(\frac{\theta_a}{\bar{L}_a}\right)^2\right] \tag{11}$$

where θ_a is the standard deviation of length-at-age a, which is estimated directly in the model fitting for age 0, and for ages 1 and above a linear relationship applies:

$$\theta_a = \begin{cases} \theta_0 & \text{for } a = 0 \\ \left((a-1)\dfrac{\theta_{14} - \theta_1}{13} + \theta_1\right) & \text{for } 1 \le a \le m \end{cases}$$

[4] Originally, the von Bertalanffy growth curve was assumed for hake. However, after the models consistently estimated straight lines for the growth curves, the panel for the 2018 International Stock Assessment Workshop recommended that the growth curve be reparameterised as a straight line. There is some evidence in the age-length key data that growth slows for older fish, and so an additional parameter *X* was introduced to allow the slope of the growth curve to be reduced after age 9. Difficulties were encountered in estimating the value of *X* (likely owing to the presence of outliers in a relatively small sample pool of older fish), and the decision was made to fix *X* at 0.5 – the difference between *X*=0.50 and *X*=1.0 was at most one or two likelihood points.

with species and gender-specific θ_0, θ_1 and θ_{14} estimated in the model fitting procedure. A penalty is added to ensure that θ_a is increasing with age, i.e. $\theta_{14} > \theta_0$.

1.4 Exploitable and survey biomasses

The model estimate of the mid-year exploitable ("available") component of biomass for each species and fleet is calculated by converting the numbers-at-age into mid-year mass-at-age and applying natural and fishing mortality for half the year:

$$B_{fy}^{ex} = \sum_g \sum_{a=0}^{m} \tilde{w}_{fy,a+1/2}^{g} S_{fya}^{g} N_{ya}^{g} e^{-Z_{y,a}^{g}/2} \qquad (12)$$

The model estimate of the survey biomass is given by:

$$B_y^{surv} = \sum_g \sum_{a=0}^{m} \tilde{w}_a^{g,surv} S_a^{g,surv} N_{ya}^{g} e^{-Z_{y,a}^{g}\frac{t^{surv}}{12}} \qquad (13)$$

where

t^{surv} is the month (on average) in which survey *surv* took place (1, 7, 9 and 4 for summer, winter, spring and autumn surveys respectively),

$S_a^{g,surv}$ is the survey selectivity of gender *g* for age *a*, converted from survey selectivity-at-length in the same manner as for the commercial selectivity (equation 9);

$\tilde{w}_a^{g,surv}$ is the survey selectivity-weighted weight-at-age *a* of gender *g* for survey *i*, computed in the same manner as for the commercial selectivity-weight-at-age (equation 10) and taking account of the timing of the survey ($\tilde{w}_{y,a}^{g,surv}$ from $P_{a,l}^{g}$ if t^{surv} is less or equal to 6 and from $P_{a+1/2,l}^{g}$ otherwise).

1.5 Initial conditions

It is assumed that the resource is at the deterministic equilibrium that corresponds to an absence of harvesting at the start of the initial year considered, i.e., $B_1^{g,sp} = K^{g,sp}$, and the year *y*=1 corresponds to 1917 when catches commence.

2. MSY and related quantities

The equilibrium catch for a fully selected fishing proportion *F** is calculated as:

$$C(F^*) = \sum_g \sum_a \tilde{w}_{a+1/2}^{g} S_a^{g} F^* N_a^{g}(F^*) \frac{1-\exp\left(-(M_a^g + S_a^g F^*)\right)}{(M_a^g + S_a^g F^*)} \qquad (14)$$

where

S_a^g is the average selectivity across all fleets, for the most recent five years:

$$S_a^g = \frac{\sum_{y=2012}^{2016}\sum_f S_{fya}^{g} F_{fy}}{\max\left(\sum_{y=2012}^{2016}\sum_f S_{fya}^{g} F_{fy}\right)} \qquad (15)$$

where the maximum is taken over ages;

and $\tilde{w}_{a+1/2}^{g}$ is the average selectivity-weighted weight-at-age, for the most recent five years:

$$\tilde{w}^g_{a+1/2} = \frac{\sum_{y=2012}^{2016} \sum_f \tilde{w}^g_{f,y,a+1/2} F_{fy}}{\sum_{y=2012}^{2016} \sum_f F_{fy}} \tag{16}$$

and with

$$N^g_a(F^*) = \begin{cases} R_0(F^*) & \text{for } a = 0 \\ N^g_{a-1}(F^*) e^{-(M^g_{a-1} + S^g_{a-1} F^*)} & \text{for } 0 < a < m \\ \dfrac{N^g_{m-1}(F^*) e^{-\left(M^g_{m-1} + S^g_{m-1} F^*\right)}}{\left(1 - e^{-\left(M^g_m + S^g_m F^*\right)}\right)} & \text{for } a = m \end{cases} \tag{17}$$

where

$$R_0\left(F^*\right) = \frac{\alpha B^{♀,sp}\left(F^*\right)}{\beta + B^{♀,sp}\left(F^*\right)} \tag{18a}$$

for a Beverton-Holt stock–recruitment relationship, and

$$R_0\left(F^*\right) = \alpha B_y^{♀,sp}\left(F^*\right) \exp\left(-\beta\left(B_y^{♀,sp}\left(F^*\right)\right)^{\gamma}\right) \tag{18b}$$

for a modified Ricker stock-recruitment relationship.

The maximum of $C\left(F^*\right)$ is then found by searching over F^* to give F^*_{MSY}, with the associated female spawning biomass given by:

$$B^{♀,sp}_{MSY} = \sum_a f^{♀}_a w^{♀}_a N^{♀}_a\left(F^*_{\mathrm{MSY}}\right) \tag{19}$$

3. The likelihood function

The model is fit to CPUE and survey biomass indices, commercial and survey length frequencies, survey age-length keys, as well as to the stock-recruitment curve to estimate model parameters. Contributions by each of these to the negative of the log-likelihood (- $\ell\mathrm{n}L$) are as follows[5].

3.1 CPUE relative biomass data

The likelihood is calculated by assuming that the observed biomass index (here CPUE) is log-normally distributed about its expected value:

$$I^i_y = \hat{I}^i_y e^{\varepsilon^i_y} \quad \text{or} \quad \varepsilon^i_y = \ln\left(I^i_y\right) - \ln\left(\hat{I}^i_y\right) \tag{20}$$

where

I^i_y is the biomass index for year *y* and series *i* (which corresponds to a specified species and fleet);

$\hat{I}^i_y = \hat{q}^i \hat{B}^{ex}_{fy}$ is the corresponding model estimate, where $\widehat{B}^{ex}_{fy}$ is the model estimate of exploitable resource biomass, given by equation 11;

$\hat{q}^i$ is the constant of proportionality for biomass series *i*;and

ε^i_y from $N\left(0,\left(\sigma^i_y\right)^2\right)$.

In cases where the CPUE series are based upon species-aggregated catches (as available pre-1978), the corresponding model estimate is derived by assuming two types of fishing zones: z1) an "*M. capensis* only zone", corresponding to shallow-water and z2) a "mixed zone" (see diagrammatic representation in Figure 1).

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[5]Strictly it is a penalised log-likelihood which is maximised in the fitting process, as some contributions that would correspond to priors in a Bayesian estimation process are added.

The total catch of hake of both species (*BS*) by fleet *f* in year *y* ($C_{BS,fy}$) can be written as:

$$C_{BS,fy} = C^{z1}_{C,fy} + C^{z2}_{C,fy} + C_{P,fy} \tag{21}$$

where

$C^{z1}_{C,fy}$ is the *M. capensis* catch by fleet *f* in year *y* in the *M. capensis* only zone (z1);

$C^{z2}_{C,fy}$ is the *M. capensis* catch by fleet *f* in year *y* in the mixed zone (z2); and

$C_{P,fy}$ is the *M. paradoxus* catch by fleet *f* in year *y* in the mixed zone.

Catch rate is assumed to be proportional to exploitable biomass. Furthermore, let γ_C be the proportion of the *M. capensis* exploitable biomass in the mixed zone ($\gamma_C = B^{ex,z2}_{C,fy} \big/ B^{ex}_{C,fy}$) (assumed to be constant throughout the period for simplicity) and ψ_{fy} be the proportion of the effort of fleet *f* in the mixed zone in year *y* ($\psi_{fy} = E^{z2}_{fy} \big/ E_{fy}$), so that:

$$C^{z1}_{C,fy} = q^{i,z1}_C B^{ex,z1}_{Cfy} E^{z1}_{fy} = q^{i,z1}_C (1-\gamma_C) B^{ex}_{C,fy} (1-\psi_{fy}) E_{fy} \tag{22}$$

$$C^{z2}_{C,fy} = q^{i,z2}_C B^{ex,z2}_{C,fy} E^{z2}_{fy} = q^{i,z2}_C \gamma_C B^{ex}_{C,fy} \psi_{fy} E_{fy} \quad \text{and} \tag{23}$$

$$C_{P,fy} = q^i_P B^{ex}_{P,fy} E^{z2}_{fy} = q^i_P B^{ex}_{P,fy} \psi_{fy} E_{fy} \tag{24}$$

where

$E_{fy} = E^{z1}_{fy} + E^{z2}_{fy}$ is the total effort of fleet *f*, corresponding to combined-species CPUE series *i* which consists of the effort in the *M. capensis* only zone (E^{z1}_{fy}) and the effort in the mixed zone (E^{z2}_{fy});

$q^{i,zj}_C$ is the catchability for *M. capensis* (*C*) for biomass series *i*,and zone *zj*; and

q^i_P is the catchability for *M. paradoxus* (*P*) for biomass series *i*.

It follows that:

$$C_{C,fy} = B^{ex}_{C,fy} E_{fy} \left[q^{i,z1}_C (1-\gamma_C)(1-\psi_{fy}) + q^{i,z2}_C \gamma_C \psi_{fy} \right] \tag{25}$$

$$C_{P,fy} = B^{ex}_{P,fy} E_{fy} q^i_P \psi_{fy} \tag{26}$$

From solving equations 25 and 26:

$$\psi_{fy} = \frac{q^{i,z1}_C (1-\gamma_C)}{\left\{ \dfrac{C_{C,fy} B^{ex}_{P,fy} q^i_P}{B^{ex}_{C,fy} C_{P,fy}} - q^{i,z2}_C \gamma_C + q^{i,z1}_C (1-\gamma_C) \right\}} \tag{27}$$

Note: a penalty is included so that $0 < \psi_{fy} < 1$.

and:

$$\hat{I}^i_y = \frac{C_{fy}}{E_{fy}} = \frac{C_{fy} B^{ex}_{P,fy} q^i_P \psi_{fy}}{C_{P,fy}} \tag{28}$$

Zone 1 (z1): *M. capensis* only	Zone 2 (z2): Mixed zone
M. capensis: biomass (B_C^{z1}), catch(C_C^{z1})	*M. capensis*: biomass (B_C^{z2}), catch(C_C^{z2}) *M. paradoxus*: biomass (B_P), catch(C_P)
Effort in zone 1 (E^{z1})	Effort in zone 2 (E^{z2})

Figure 1: Diagrammatic representation of the two conceptual fishing zones.

Two species-aggregated CPUE indices are available: the ICSEAF West Coast and the ICSEAF South Coast series. For consistency, q's for each species (and zone) are forced to be in the same proportion:

$$q_s^{SC} = rq_s^{WC} \tag{29}$$

The contribution of the CPUE data to the negative of the log-likelihood function (after removal of constants) is then given by:

$$-\ln L^{CPUE} = \sum_i \sum_y \left[\ln\left(\sigma_y^i\right) + \left(\varepsilon_y^i\right)^2 / 2\left(\sigma_y^i\right)^2 \right] \tag{30}$$

where

σ_y^i is the standard deviation of the residuals for the logarithms of index i in year y.

Homoscedasticity of residuals for CPUE series is customarily assumed[6], so that $\sigma_y^i = \sigma^i$ is estimated in the minimisation process. To correct for possible negative bias in estimates of variance (σ^i) and to avoid according unrealistically high precision (and so giving inappropriately high weight) to the CPUE data, lower bounds on the standard deviations of the residuals for the logarithm of the CPUE series have been enforced: for the historical ICSEAF CPUE series (separate West Coast and South Coast series) the lower bound is set to 0.25, and to 0.15 for the recent GLM-standardised CPUE series, i.e.: $\sigma^{ICSEAF} \geq 0.25$ and $\sigma^{GLM} \geq 0.15$.

In the case of the species-disaggregated CPUE series, the catchability coefficient q^i for biomass index i is estimated by its maximum likelihood value, which in the more general case of heteroscedastic residuals is given by:

$$\ln \hat{q}^i = \frac{\sum_y \left(\ln I_y^i - \ln \hat{B}_{fy}^{ex}\right) / \left(\sigma_y^i\right)^2}{\sum_y 1 / \left(\sigma_y^i\right)^2} \tag{31}$$

In the case of the species-combined CPUE, $q_C^{WC,z1}$, $q_C^{WC,z2}$, q_P^{WC}, r and γ_C are estimated directly in the fitting procedure.

3.2 Survey biomass data

Data from the research surveys are treated as relative biomass indices in a similar manner to the species-disaggregated CPUE series above, with survey selectivity function $S_a^{g,sum/win}$ replacing the commercial selectivity S_{fya}^g (see equation 13 above, which also takes account of the timing of the survey).

An estimate of sampling variance is available for most surveys and the associated σ_y^i is generally taken to be given by the corresponding survey CV. However, these estimates likely fail to include all sources of variability, and unrealistically high precision (low variance and hence high weight) could hence be accorded to these indices. The contribution of the

[6]There are insufficient data in any series to enable this to be tested with meaningful power.

survey data to the negative log-likelihood is of the same form as that of the CPUE biomass data (see equation 30). The procedure adopted takes into account an additional variance $(\sigma_A)^2$ which is treated as another estimable parameter in the minimisation process, i.e:

$$-\ln L^{Survey} = \sum_i \sum_y \left[\ln\left(\sqrt{(\sigma_y^i)^2 + (\sigma_A)^2} \right) + (\varepsilon_y^i)^2 / 2\left((\sigma_y^i)^2 + (\sigma_A)^2 \right) \right] \tag{32}$$

This procedure is carried out enforcing the constraint that $(\sigma_A)^2 > 0$, i.e. the overall variance cannot be less than its externally input component.

In June 2003, the trawl gear on the *Africana* was changed and a different value for the multiplicative bias factor q is taken to apply to the surveys conducted with the new gear. Calibration experiments have been conducted between the *Africana* with the old gear (hereafter referred to as the "old *Africana*") and the *Nansen*, and between the *Africana* with the new gear ("new *Africana*") and the *Nansen*, in order to provide a basis to relate the multiplicative biases of the *Africana* with the two types of gear (q_{old} and q_{new}). A recent calibration analysis based on "Model 1" (see Table 1, "Model 1" of Smith *et al*., 2013) provided the following estimates:

$(q^{new}/q^{old})^{capensis} = 0.652$ with SE=0.073 and
$(q^{new}/q^{old})^{paradoxus} = 0.883$ with SE=0.082.

The following contribution is therefore added as a penalty (or a log prior in a Bayesian context) to the negative log-likelihood in the assessment:

$$-\ln L^{q-ch} = \sum_i (\ln q_{new} - \ln q_{old} - \Delta \ln q)^2 \big/ 2\sigma^2_{\Delta \ln q} \tag{33}$$

A different length-specific selectivity is estimated for the "old *Africana*" and the "new *Africana*", see section 4.1.2 below. The commercial vessel recently used in place of the *Africana* is assumed to have the same q and same selectivity as the *Africana* with the new net.

For the surveys, the q's are estimated directly in the model fitting procedure.

3.3. Commercial proportions at length

Commercial proportions at length from the offshore trawl fleet cannot be disaggregated by species and gender as the data collected did not distinguish these. The model is therefore fit to the proportions at length as determined for both species and gender combined. The catches made by the inshore trawl fleet are assumed to consist of *M. capensis* only, and species and sex information is available over the 2000-2010 period for the longline fleet.

The catches at length are computed as:

$$C_{fyl}^{sg} = \sum_{a=0}^{m} N_{sya}^{g} F_{sfy} S_{sfyl}^{g} P_{s,a+1/2,l}^{g} \frac{1-e^{-Z_{ya}^{g}}}{Z_{ya}^{g}} \tag{34}$$

Where appropriate, the catches at length are summed over species and gender.

The predicted proportions at length are computed as:

$$\hat{p}_{fyl} = \sum_s \sum_g C_{fyl}^{sg} \Big/ \sum_s \sum_g \sum_{l'} C_{fyl'}^{sg} \tag{35a}$$

for species- and sex-aggregated series (offshore trawl data),

$$\hat{p}_{fyl}^{s} = \sum_g C_{fyl}^{sg} \Big/ \sum_g \sum_{l'} C_{fyl'}^{sg} \tag{35b}$$

for sex-aggregated series (inshore trawl data and some longline data), and

$$\hat{p}^{sg}_{fyl} = C^{sg}_{fyl} \Big/ \sum_{l'} C^{sg}_{fyl'} \tag{35c}$$

for sex-disaggregated series (2000-2010 longline data).

The commercial proportions at length are grouped into 2cm length classes.

Due to the sex-imbalance of some of the catch data, some of the sex-disaggregated catch proportions are very small for all lengths for a particular gender (e.g. males *M. paradoxus* in the west coast longline catches). To deal with these small numbers, a modified "*sqrt(p)*" method is used to compute the contribution to the CAL data to the negative of the log-likelihood function instead of the Punt-Kennedy method (Punt and Kennedy, 1997) used previously. The formulation mimics a multinomial form for the error distribution by forcing a near-equivalent variance-mean relationship for the error distributions. The modification made to the method is to use a power of 0.35 instead of 0.50 to address homoscedasticity of the residuals (see Appendix B of MARAM/IWS/2018/Hake/P2).

$$-\ell n L^{\mathrm{CAL}} = 0.1 \sum_y \sum_l \left[\ell n\left(\sigma^i_{len}\right) + \left(\left({p^i_{yl}}^{0.35}\right) - \left({\hat{p}^i_{yl}}^{0.35}\right)\right)^2 / 2\left(\sigma^i_{len}\right)^2 \right] \tag{36}$$

where

the superscript '*i*' refers to a particular series of proportions at length data which reflect a specified fleet, species and sex (or combination thereof); and

σ^i_{len} is the standard deviation associated with the proportion at length data, which is estimated in the fitting procedure by:

$$\hat{\sigma}^i_{len} = \sqrt{\sum_y \sum_l \left(\left(p^i_{yl}\right)^{0.35} - \left(\hat{p}^i_{yl}\right)^{0.35}\right)^2 / \sum_y \sum_l 1} \tag{37}$$

In the case of sex-disaggregated CAL data, the standard deviation is computed for each gender separately.

The initial 0.1 multiplicative factor in equation 34 reflects a somewhat arbitrary downweighting to allow for correlation between proportions in adjacent length groups. The coarse basis for this adjustment is the ratio of effective number of age-classes present to the number of length groups in the minimisation, under the argument that independence in variability is likely to be more closely related to the former.

3.4. Survey proportions at length

The survey proportions at length are incorporated into the negative of the log-likelihood in an analogous manner to the commercial catches-at-age, using the modified *sqrt(p)* formulation (equation 34).

$p^{g,surv}_{syl} = \dfrac{C^{g,surv}_{syl}}{\sum_g \sum_{l'} C^{g,surv}_{syl'}}$ is the observed proportion of fish of species *s*, gender *g* and length *l* from survey *surv* in year *y*; and

$\hat{p}^{g,surv}_{syl}$ is the expected proportion of fish of species *s*, gender *g* and length *l* in year *y* in the survey *surv*, given by:

$$\hat{p}^{g,surv}_{syl} = \frac{\sum_a S^{g,surv}_{sl} P^g_{s,a+1/2,l} N^g_{sya} e^{-Z^g_{y,a}\frac{t^{surv}}{12}}}{\sum_g \sum_{l'} \sum_a S^{g,surv}_{sl'} P^g_{s,a+1/2,l'} N^g_{sya} e^{-Z^g_{y,a}\frac{t^{surv}}{12}}} \tag{38}$$

All juveniles fish (<21cm) are assumed to be of unknown sex, so that the numerator in equation 38 above is also summed over *g* and similarly for surveys for which sex-disaggregation is not available.

The survey proportions at length are grouped into 2cm length classes.

The 2017 model did not make use of any minus and plus groups for the commercial and survey proportions-at-length data. However, the presence of many near-zero cells for residuals resulted in negatively biased CAL sigma values, which in turn resulted in very large negative log-likelihood contributions for the CAL data (see MARAM/IWS/2018/Hake/P2). To address this issue, new plus-minus groups were imposed that are data-type dependent, but year-independent. The plus and minus groups that have been used in the RC assessment are listed in the Table below.

1. Commercial sex-aggregated	Minus group	Plus group
West Coast offshore	19	81
South Coast offshore	19	81
South Coast inshore	19	81
West Coast longline	37	101
South Coast Longline	37	101
2. Commercial sex-disaggregated	**Minus group**	**Plus group**
WC longline *M. paradoxus*	37	101
WC longline *M. capensis*	37	101
SC longline *M. paradoxus*	37	101
SC longline *M. capensis*	37	101
3. Survey sex-aggregated	**Minus group**	**Plus group**
WC summer *M. paradoxus*	5	75
WC winter *M. paradoxus*	5	75
SC spring *M. paradoxus*	11	75
SC autumn *M. paradoxus*	11	75
WC summer *M. capensis*	5	75
WC winter *M. capensis*	5	75
SC spring *M. capensis*	5	75
SC autumn *M. capensis*	5	75
4. Survey sex-disaggregated	**Minus group**	**Plus group**
WC summer *M. paradoxus*	5	75
SC spring *M. paradoxus*	11	75
SC autumn *M. paradoxus*	11	75
WC summer *M. capensis*	5	75
SC spring *M. capensis*	5	75
SC autumn *M. capensis*	5	75

3.5. Age-length keys

Under the assumption that fish are sampled randomly with respect to age within each length-class, the contribution to the negative log-likelihood for the ALK data (ignoring constants) is:

$$-lnL^{ALK} = -w\sum_i\sum_l\sum_a\left[A_{ial}^{obs}ln\left(\hat{A}_{ial}\right) - A_{ial}^{obs}ln\left(A_{ial}^{obs}\right)\right] \qquad (39)$$

where

w is a downweighting factor to allow for overdispersion in these data compared to the expectation for a multinomial distribution with independent data; this downweighting factor is somewhat arbitrarily set to 0.01 to avoid these data overriding trend information in the indices of biomass;

A_{ial}^{obs} is the observed number of fish of size class *l* that have been read as of age *a* for ALK *i* (a specific combination of survey, year, species and gender);

$\hat{A}_{ial}$ is the model estimate of A_{ial}^{obs}, computed as:

$$\hat{A}_{ial} = W_{il}\frac{\tilde{C}_{ial}}{\sum_{a'}\tilde{C}_{ia'l}} \qquad (40)$$

where the survey catches-at-length are given by:

$$\tilde{C}^{surv}{}_{ial} = N_{sya}^{g}\tilde{P}_{a,l}S_l^i e^{-Z_{y,a}^{g}\frac{t^i}{12}} \qquad (41a)$$

and the commercial catches-at-length are given by:

$$\tilde{C}^{comm}{}_{ial} = N_{sya}^{g}\tilde{P}_{a,l}S_l^i\frac{1-e^{-Z_{ya}^{g}}}{Z_{ya}^{g}} \qquad (41b)$$

Here

S_l^i is the selectivity-at-length *l* for ALK i,

t^i is the month (on average) in which the ALK was sampled ($= t^{surv}$ (equation 13) for surveys)

$W_{i,l}$ is the number of fish in length class *l* that were aged for ALK *i*,

$\tilde{P}_{a,l} = \sum_a Y(a'|a) P_{a,l}$ is the ALK for age a and length *l* after accounting for age-reading error,

with

$Y(a'|a)$ the age-reading error matrix, representing the probability of an animal of true age *a* being aged to be that age or some other age a'.

$\tilde{P}_{a,l}$ takes account of the timing of the age-length sampling (from $P_{a+1/2,l}$ for commercial samples and survey samples if t^{surv} is greater than 6 and from $P_{a,l}$ otherwise).

Note: All aged animals less than 21cm in length are assumed to be juveniles, i.e. of unknown gender. Outliers, defined as the data points lying outside the mean ± 3s.d. for each age (mean and s.d. calculated across all years and surveys) have been discarded.

The age-length information is grouped into 2cm length classes.

Age-reading error matrices have been computed for each reader and for each species. When multiple readers age the same fish, these data are considered to be independent information in the model fitting.

3.6 Stock-recruitment function residuals

The stock-recruitment residuals are assumed to be log-normally distributed. Thus, the contribution of the recruitment residuals to the negative of the log-likelihood function is given by the penalty function:

$$-\ln L^{SR} = \sum_s \left[\sum_{y=y1}^{y2} \varsigma_{sy}{}^2 \Big/ 2\sigma_R^2 \right] \tag{42}$$

where

ς_{sy} is the recruitment residual for species *s*, and year *y*, which is assumed to be log-normally distributed with standard deviation σ_R and which is estimated for year *y1* to *y2* (see equation 4) (estimating the stock-recruitment residuals is made possible by the availability of catch-at-age data, which give some indication of the age-structure of the population); and

σ_R is the standard deviation of the log-residuals, which is input.

The stock-recruitment residuals are estimated for years 1985 to 2016, with recruitment for other years being set deterministically (i.e. exactly as given by the estimated stock-recruitment curve) as there is insufficient catch-at-age information to allow reliable residual estimation for earlier years. A limit on the recent recruitment fluctuations is set by having the σ_R (which measures the extent of variability in recruitment) decreasing linearly from 0.45 in 2012 to 0.1 in 2016 (or more generally over the last five years of the assessment), thereby effectively forcing recruitment over the last years to lie closer to the stock-recruitment relationship curve.

The detailed contributions to the negative log-likelihood are given in **Table 2** for the Reference Case.

4. Model parameters

4.1 Estimable parameters

The primary parameters estimated are the species-specific female virgin spawning biomass $\left(K_s^{sp}\right)$ and steepness (h_s) and γ (for the modified Ricker curve used in the Reference Case, see equation 4b) of the stock-recruitment relationship. The standard deviations σ^i for the CPUE series residuals (the species-combined as well as the GLM-standardised series) as well as the additional variance $\left(\sigma_A^i\right)^2$ for each species and survey q's are treated as estimable parameters in the minimisation process. Similarly, in the case of the species-combined CPUE, $q_C^{WC,z1}$, $q_C^{WC,z2}$, q_P^{WC}, ρ and γ_C are directly estimated in the fitting procedure.

The species- and gender-specific von Bertalanffy growth curve parameters (l_∞, κ and t_0) are estimated directly in the model fitting process, as well as the θ_0 , $\theta_1$and θ_{14}, values used to compute the standard deviation of the length-at-age *a*.

Stock-recruitment residuals ς_{sy} are estimable parameters in the model fitting process. They are estimated separately for each species from 1985 to the present, and set to zero pre-1985 because there are no catch-at-length data for that period to provide the information necessary to inform estimation.

All the estimable parameters apart from the selectivity parameters are listed in **Table 3**, with the bounds enforced and their values as estimated for the Reference Case.

The following parameters are also estimated in the model fits undertaken (if not specifically indicated as fixed).

4.1.1 Natural mortality:
The natural mortality-at-age vectors are fixed at the values estimated in the hake predation model see MARAM/IWS/2018/Hake/BG7), and are listed in the Table below.

Age	*M. paradoxus*	*M. capensis*
0	0.839	0.907
1	0.820	0.803
2	0.792	0.648
3	0.710	0.494
4	0.659	0.344
5	0.608	0.319
6	0.548	0.291
7	0.457	0.263
8	0.362	0.237
9	0.286	0.218
10	0.237	0.207
11	0.213	0.202
12	0.203	0.200
13	0.200	0.200
14	0.200	0.200
15	0.200	0.200

4.1.2 Survey fishing selectivity-at-length:

The survey selectivities are all modelled by a double normal shape as recommended by the International Panel (Smith *et al*., 2013). Thus the selectivity-at-length for each species, sex, gear and survey is estimated by the following functional form:

$$S_l = \begin{cases} \exp\left(-\dfrac{(l-l_{\max})^2}{2\sigma_{Left}^2}\right) & \text{for } l \le l_{\max} \\ \exp\left(-\dfrac{(l-l_{\max})^2}{2\sigma_{Right}^2}\right) & \text{for } l > l_{\max} \end{cases} \qquad (45)$$

where σ_{Left} , σ_{Right} and $l_{\max}$ are estimable parameters.

For the surveys, different selectivities can potentially be estimated for all of the following “effects”:

a. Species (*M. paradoxus*/*M. capensis*),
b. Coasts (West coast/South coast),
c. Seasons (Summer/Winter/Spring/Autumn),
d. Gear (*Africana* old/new gear), and
e. Gender (males/females).

Note that selectivity is always 1 for $l=l_{max}$ except for females *M. paradoxus* on the South Coast, for which the maximum female selectivity is always set at an estimable proportion of the maximum of 1 for the males.

To select an appropriate combination, several runs have been carried out, estimating the selectivities including one or more different effects. The final run selected involves maintaining the same parameters for each sex and gear across other effects, except for estimating a fixed multiplicative change to the σ_{Right} parameter if sex is female (Δ_{fem}) and also if new gear is used (Δ_{gear}). This multiplicative change is species and coast dependent, i.e.:

$$\sigma_{Right,f,g} = \begin{cases} \sigma_{Right} & \text{if } f = \text{old gear, and } g = \text{males} \\ \sigma_{Right}\Delta_{fem} & \text{if } f = \text{old gear, and } g = \text{females} \\ \sigma_{Right}\Delta_{gear} & \text{if } f = \text{new gear, and } g = \text{males} \\ \sigma_{Right}\Delta_{fem}\Delta_{gear} & \text{if } f = \text{new gear, and} g = \text{females} \end{cases} \tag{46}$$

With σ_{Right}, Δ_{fem} and Δ_{gear} estimated separately for each for each species and coast combination.

Details of the survey selectivities (including the values estimated in the Reference Case) are shown in **Table 4**.

Selectivities-at-length are converted to selectivities-at-age using the begin-year age-length matrix for the summer and autumn surveys, and the mid-year age-length matrix for winter and spring surveys.

4.1.3 Commercial fishing selectivity-at-length:

As for the survey selectivities, the commercial fishing selectivity-at-length for each species and fleet, S_{sfl} , is estimated in terms of a double normal curve.

Periods of fixed and changing selectivity have been assumed for the offshore trawl fleet to take account of the change in the selectivity at low ages over time in the commercial catches, likely due to the phasing out of the (illegal) use of net liners to enhance catch rates.

Two selectivity periods are also assumed for the longline fleet.

On the South Coast, for *M. paradoxus*, the female offshore trawl selectivity (only the trawl fleet is assumed to catch *M. paradoxus* on the South Coast) is scaled down by a factor taken as the average of those estimated for the South Coast spring and autumn surveys. Although there is no gender information for the commercial catches, the South Coast spring and autumn surveys catch a much higher proportion of male *M. paradoxus* than female (ratios of about 7:1 and 3.5:1 for spring and autumn respectively). This is assumed to reflect a difference in distribution of the two genders which would therefore affect the commercial fleet similarly.

Details of the fishing selectivities (including the number of parameters estimated and their values as estimated in the Reference Case) are shown in **Table 5**.

4.2 Input parameters and other choice for application to hake

4.2.1 Age-at-maturity:

The proportion of fish of species *s*, gender *g* and length *l* that are mature is assumed to follow a logistic curve with the parameter values given in **Table 6**:

$$f_{sl}^{g} = \left(1 + e^{\frac{l_{50}^{s,g} - l}{\Delta^{s,g}}}\right)^{-1} \tag{45}$$

Maturity-at-length is then converted to maturity-at-age as follows:

$$f_{sa}^{g} = \sum_{l} f_{sl}^{g} P_{a,l}^{g} \tag{46}$$

with maturity at age 0 set to 0.

4.2.2 Weight-at-length:

The weight-at-length for each species and gender is calculated from the mass-at-length function, with values of the parameters for this function listed in **Table 7**:

$$w_l = \alpha l^\beta \tag{47}$$

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Table 2: Negative log-likelihood contributions for the 2018 Reference Case.

		Total	Both spp.	*M. paradoxus*	*M. capensis*
-lnL total		-3144.8			
ICSEAF CPUE	WC	-36.6	-28.21		
ICSEAF CPUE	SC		-8.4		
GLM CPUE	WC	-202.6		-61.4	-52.8
GLM CPUE	SC			-49.1	-39.3
Survey	WC summer	-34.6		-15.1	-2.0
Survey	WC winter			-3.1	-0.8
Survey	SC spring			2.5	-4.9
Survey	SC autumn			4.9	-16.0
Commercial sex-aggregated CAL	WC offshore	-827.4	-255.4		
Commercial sex-aggregated CAL	SC offshore		-227.3		
Commercial sex-aggregated CAL	SC inshore				-263.9
Commercial sex-aggregated CAL	WC longline		-43.0		
Commercial sex-aggregated CAL	SC longline				-37.9
Commercial sex-disaggregated CAL	WC longline	-681.0		-229.6	-174.8
Commercial sex-disaggregated CAL	SC longline			-209.2	-67.4
Survey sex-aggreagted CAL	WC summer	-412.5		-96.8	-70.9
Survey sex-aggreagted CAL	WC winter			-50.7	-44.1
Survey sex-aggreagted CAL	SC spring			-30.5	-42.3
Survey sex-aggreagted CAL	SC autumn			-36.5	-40.6
Survey sex-disaggreagted CAL	WC summer	-1089.8		-314.6	-241.2
Survey sex-disaggreagted CAL	SC spring			-44.7	-54.7
Survey sex-disaggreagted CAL	SC autumn			-179.0	-255.6
Age-length keys		129.9			
SR residuals		9.5		3.1	6.4

Table 3: Parameters estimated in the model fitting procedure, excluding selectivity parameters, with bounds enforced and values as estimated for the Reference Case.

Estimable parameter	Bounds enforced		Reference Case estimates			
			M. paradoxus		*M. capensis*	
ln(K)	(3.5;10)		5.635		5.608	
h	(0.5;2)		1.632		2.000	
γ	(0;2)		0.512		0.884	
ζ	(-5;5)	1985	-0.392		-0.061	
		1986	-0.171		0.190	
		1987	0.278		0.536	
		1988	0.035		0.579	
		1989	0.095		0.528	
		1990	0.068		0.389	
		1991	0.087		0.167	
		1992	-0.109		0.053	
		1993	0.214		0.280	
		1994	0.197		0.190	
		1995	0.278		-0.025	
		1996	-0.215		0.144	
		1997	-0.070		0.115	
		1998	-0.268		-0.092	
		1999	-0.294		-0.139	
		2000	0.007		0.049	
		2001	0.153		-0.181	
		2002	-0.375		-0.369	
		2003	-0.177		-0.154	
		2004	0.319		-0.030	
		2005	0.135		-0.035	
		2006	-0.025		-0.194	
		2007	-0.109		-0.227	
		2008	0.227		-0.258	
		2009	-0.199		-0.623	
		2010	0.006		-0.462	
		2011	-0.169		-0.390	
		2012	0.058		-0.313	
		2013	0.213		0.068	
		2014	0.209		0.089	
		2015	0.042		0.173	
		2016	-0.030		0.005	
		2017	-0.017		-0.002	
$(\sigma_A)^2$	(0;0.5)		0.179		0.144	
σ_{ICSEAF}^{WC}	(0.25;1)	0.25				
σ_{ICSEAF}^{SC}	(0.25;1)	0.25				
σ_{GLM}^{WC}	(0.15;1)		0.150		0.157	
σ_{GLM}^{sC}	(0.15;1)		0.172		0.221	
ICSEAF CPUE						
$q_C^{WC,z1}$	(0;10)				0.116	
$q_C^{WC,z2}$	(0;10)				9.906	
q_p^{WC}	(0;10)		0.035			
r	(0;10)		0.072			
γ_c	(0;2)				0.005	
survey lnq	(-5;2)		Old gear	New gear	Old gear	New gear
WC summer			0.528	0.409	0.112	-0.292
WC winter			0.101		0.166	
SC spring			-0.095	-0.179	-0.046	-0.447
SC autumn			0.044	-0.113	0.206	-0.213
Age-length dbn			Males	Females	Males	Females
θ_0	(0.1;100)		2.611	2.644	2.611	2.644
θ_1	(0.01;100)		4.347	4.362	4.584	5.067
θ_{14}	(0.01;100)		9.180	11.628	6.824	6.446
L_2	(5;50)		24.260	20.739	26.741	25.649
L_5	(20;70)		43.192	40.616	44.746	44.624

Table 4: Details for the survey selectivities-at-length for each species for the Reference Case. All selectivities are assumed to have a double normal shape. The Reference Case values are given, with the values estimated shown in bold.

	M. paradoxus					*M. capensis*				
	σ_{left}	σ_{right}	l_{max}		No. of est. parameters	σ_{left}	σ_{right}	l_{max}		No. of est. parameters
West Coast summer	Δ_{len}=	**2.271**	Δ_{NG}=	**0.924**		Δ_{len}=	**1.647**	Δ_{NG}=	**1.072**	
Males, old gear	**22.391**	**4.129**	**14.254**			**13.885**	**1.826**	**20.055**		
Females, old gear	22.391	9.376	14.254		5	13.885	3.007	20.055		5
Males, new gear	22.391	3.817	14.254			13.885	1.958	20.055		
Females, new gear	22.391	8.668	14.254			13.885	3.225	20.055		
West coast winter	Δ_{len}=	2.271	Δ_{NG}=	-		Δ_{len}=	1.647	Δ_{NG}=	-	
Males, old gear	**22.956**	**3.960**	**29.205**			**21.659**	**2.867**	**15.476**		
Females, old gear	22.956	8.993	29.205		3	21.659	4.721	15.476		3
Males, new gear	-	-	-			-	-	-		
Females, new gear	-	-	-			-	-	-		
South Coast spring	Δ_{len}=	**75420.002**	Δ_{NG}=	**1.436**		Δ_{len}=	**1.540**	Δ_{NG}=	**0.802**	
Males, old gear	**32.363**	**3.337**	**4.717**			**54.339**	**21.537**	**10.890**		
Females, old gear	32.363	251670.608	4.717		6	54.339	33.173	10.890		5
Males, new gear	32.363	4.793	4.717			54.339	17.276	10.890		
Females, new gear	32.363	361470.323	4.717			54.339	26.609	10.890		
	Female selectivities multiplicatively scaled by **0.085**									
South coast autumn	Δ_{len}=	75420.002	Δ_{NG}=	1.436		Δ_{len}=	1.540	Δ_{NG}=	0.802	
Males, old gear	**33.596**	**3.410**	**6.669**			**48.360**	**14.870**	**12.666**		
Females, old gear	33.596	257191.127	6.669		4	48.360	22.903	12.666		3
Males, new gear	33.596	4.898	6.669			48.360	11.928	12.666		
Females, new gear	33.596	369399.354	6.669			48.360	18.372	12.666		
	Female selectivities multiplicatively scaled by **0.237**									

Table 5: Details for the commercial selectivities-at-length for each fleet and species combination for the Reference Case. All selectivities are assumed to have the double normal shape. The Reference Case values are given, with the values estimated shown in bold.

	M. paradoxus					***M. capensis***				
	σ_{left}	σ_{right}	l_{max}		No. est. param.	σ_{left}	σ_{right}	l_{max}		No. est. param.
1. WC off. trawl										
1917-1976	As 1989 selectivity					As 1989 selectivity				
1977-1984	Estimated	Estimated	Estimated			As 1993-2016		As 1993-2016 - Δ_{para}		
	32.852	**3.427**	**2144770.5**			39.434	13.384	= 20.12-(	-2144746.33)	
1985-1992	Linear change between 1984 and 1993				6	Linear change between 1984 and 1993				0
1993-2016	Estimated	Estimated	Estimated			As inshore	As inshore*3	As inshore+5		
	33.843	**3.427**	**24.155**			39.434	13.384		20.118	
	Δ_{para}	=24.2-	2144770.48=	-2144746						
2. SC off. trawl										
1917-1976	As 1989 selectivity					As 1989 selectivity				
1977-1984	As 1993-2016		As 1993-2016 - Δ_{para}			As 1993-2016		As 1993-2016 - Δ_{para}		
	34.590	3.336	=7720628-(	-2144746)	3	39.434	13.384	= 20.12-(	-2144746.33)	0
1985-1992	Linear change between 1984 and 1993					Linear change between 1984 and 1993				
1993-2016	Estimated	Estimated	Estimated			As inshore	As inshore*3	As inshore+5		
	34.590	**3.336**	**7720628.3**			39.434	13.384		20.118	
3. SC insh. trawl						Estimated	Estimated	Estimated		
					0	**39.434**	**4.461**		**15.118**	3
4. WC longline										
	Males					Males				
1984-1999			Estimated					Estimated		
	same for all periods	same for all periods	**78.758**			same for all periods	same for all periods	**63.686**		
2000-2005			est-shift 1					est-shift 1		
			=78.758-	**5.739**				=63.686-(	**-1.368)**	
2006-2016	**8.747**	**8.083**	est-shift2			**7.394**	**9.924**	est-shift2		
			=78.758-	**7.471**	8			=63.686-	**0.116**	8
	Females					Females				
1984-1999			Estimated					Estimated		
	same for all periods	same for all periods	**77.407**			same for all periods	same for all periods	**69.275**		
2000-2005			est-shift 1					est-shift 1		
			=77.407-	5.739				=69.275-(	-1.368)	
2006-2016	**7.436**	**8.528**	est-shift2			**8.096**	**9.022**	est-shift2		
			=77.407-	7.471				=69.275-	0.116	
5. SC longline										
	Males					Males				
1984-1999			Estimated					Estimated		
	same for all periods	same for all periods	**28.662**			same for all periods	same for all periods	**65.190**		
2000-2005			est-shift 1					est-shift 1		
			=28.662-(	**-37.997)**				=65.190-(	**2.416)**	
2006-2016	**6.804**	**7.710**	est-shift2			**6.440**	**9.127**	est-shift2		
			=28.662-(	**-33.632)**	8			=65.190-(	**3.421)**	8
	Females					Females				
1984-1999			Estimated					Estimated		
	same for all periods	same for all periods	**33.909**			same for all periods	same for all periods	**70.807**		
2000-2005			est-shift 1					est-shift 1		
			=33.909-(	-37.997)				=70.807-(	2.416)	
2006-2016	**8.459**	**5.044**	est-shift2			**7.701**	**9.427**	est-shift2		
			=33.909-(	-33.632)				=70.807-	3.421	
5. SC handline						Average of inshore and SC longline female				
	-	-	-		0	23.765	6.742		42.138	0

Table 6: Female maturity-at-length ogive (equation 44) parameter estimates (from Singh *et al*. 2013).

	l_{50} (cm)	Δ (cm)
M. paradoxus	41.526	2.979
M. capensis	53.825	10.144

Table 7: Length-weight relationship estimates (from Singh 2013).

	α (gm/cm$^{\beta}$)	β
M. paradoxus:		
Males	0.007750	2.977
Females	0.005700	3.071
M. capensis:		
Males	0.006750	3.044
Females	0.005950	3.075

Appendix A: Reference Case data

The data listed below correspond to the data in the master data file "20181109 V1.0 Input Data Master File.xlsx".

Table App.A.1a: Species-disaggregated catches (in thousand tons) by fleet of South African hake from the south and west coasts for the period 1917-1977. The offshore catches have been split between species using the Model A6b species splitting algorithm (MARAM/IWS/2018/Hake/BG6).

	M. paradoxus	*M. capensis*
	Offshore	Offshore
	WC	WC
1917	0.000	1.000
1918	0.000	1.100
1919	0.000	1.900
1920	0.000	0.000
1921	0.000	1.300
1922	0.000	1.000
1923	0.000	2.500
1924	0.000	1.500
1925	0.000	1.900
1926	0.000	1.400
1927	0.000	0.800
1928	0.000	2.600
1929	0.000	3.800
1930	0.000	4.400
1931	0.000	2.800
1932	0.000	14.300
1933	0.000	11.100
1934	0.000	13.800
1935	0.000	15.000
1936	0.000	17.700
1937	0.000	20.200
1938	0.000	21.100
1939	0.000	20.000
1940	0.000	28.600
1941	0.000	30.600
1942	0.001	34.499
1943	0.001	37.899
1944	0.002	34.098
1945	0.004	29.196
1946	0.010	40.390
1947	0.020	41.380

	M. paradoxus		*M. capensis*		
	Offshore		Offshore		Inshore
	WC	SC	WC	SC	SC
1948	0.056	-	58.744	-	-
1949	0.106	-	57.294	-	-
1950	0.257	-	71.743	-	-
1951	0.620	-	88.880	-	-
1952	1.188	-	87.612	-	-
1953	2.395	-	91.105	-	-
1954	5.092	-	100.308	-	-
1955	10.229	-	105.171	-	-
1956	18.335	-	99.865	-	-
1957	31.885	-	94.515	-	-
1958	48.593	-	82.107	-	-
1959	71.733	-	74.267	-	-
1960	94.095	-	65.805	-	1.000
1961	97.390	-	51.310	-	1.308
1962	102.622	-	44.978	-	1.615
1963	121.695	-	47.805	-	1.923
1964	118.512	-	43.788	-	2.231
1965	149.541	-	53.459	-	2.538
1966	144.301	-	50.699	-	2.846
1967	131.066	4.260	45.634	9.926	3.154
1968	106.642	8.391	36.958	19.517	3.462
1969	122.685	11.412	42.415	26.518	3.769
1970	105.925	7.140	36.575	16.583	4.077
1971	150.177	9.065	51.823	21.050	4.385
1972	181.368	14.057	62.565	32.639	4.692
1973	117.318	21.782	40.464	50.574	5.000
1974	91.458	27.351	31.542	63.502	10.056
1975	66.637	20.310	22.980	47.153	6.372
1976	106.996	15.634	36.898	36.296	5.740
1977	76.089	11.131	26.239	25.841	3.500

Table App.A.1b: Species-disaggregated catches (in thousand tons) by fleet of South African hake from the south and west coasts for the period 1978-present. The recent offshore trawl catches are from MARAM/IWS/2018/Hake/BG6, the recent inshore and handline catches are from Rob Cooper (pers. commn) and the new longline catches from Sobahle Somhlaba (pers. commn).

	M. paradoxus				*M. capensis*					
	Offshore		Longline		Offshore		Inshore	Longline		Handline
	WC	SC	WC	SC	WC	SC	SC	WC	SC	SC
1978	101.042	3.220	-	-	26.470	4.365	4.931	-	-	-
1979	94.331	1.924	-	-	39.192	4.995	6.093	-	-	-
1980	99.654	2.206	-	-	33.873	4.254	9.121	-	-	-
1981	88.883	0.910	-	-	32.048	4.575	9.400	-	-	-
1982	83.618	3.353	-	-	29.732	8.005	8.089	-	-	-
1983	71.238	4.723	0.126	-	23.195	7.792	7.672	0.104	-	-
1984	82.358	3.796	0.200	0.005	28.897	7.139	9.035	0.166	0.011	-
1985	94.428	8.059	0.638	0.091	30.642	11.957	9.203	0.529	0.201	0.065
1986	103.756	8.580	0.753	0.094	30.049	7.385	8.724	0.625	0.208	0.084
1987	93.517	7.459	1.952	0.110	24.008	8.225	8.607	1.619	0.243	0.096
1988	79.913	5.876	2.833	0.103	26.669	8.640	8.417	2.350	0.228	0.071
1989	82.230	6.182	0.158	0.010	25.029	12.730	10.038	0.132	0.022	0.137
1990	81.996	9.341	0.211	-	21.640	13.451	10.012	0.175	-	0.348
1991	87.093	12.448	-	0.932	19.357	9.626	8.206	-	2.068	1.270
1992	84.768	17.297	-	0.466	18.519	9.165	9.252	-	1.034	1.099
1993	102.125	9.880	-	-	15.940	4.380	8.870	-	-	0.278
1994	103.541	6.726	0.882	0.194	20.327	4.326	9.569	0.732	0.432	0.449
1995	100.268	4.004	0.523	0.202	20.629	3.146	10.630	0.434	0.448	0.756
1996	107.381	8.966	1.308	0.568	21.794	4.323	11.062	1.086	1.260	1.515
1997	100.654	10.509	1.410	0.582	16.500	5.327	8.834	1.170	1.290	1.404
1998	111.154	9.742	0.505	0.457	16.499	4.411	8.283	0.419	1.014	1.738
1999	88.581	11.420	1.532	1.288	15.179	3.926	8.595	1.272	2.856	2.749
2000	96.587	7.700	2.706	3.105	21.114	5.830	10.906	2.000	1.977	5.500
2001	101.247	7.850	1.417	0.084	16.349	8.306	11.836	2.394	1.527	7.300
2002	91.207	12.443	4.469	1.585	13.724	6.141	9.581	2.391	2.546	3.500
2003	93.711	17.397	3.305	1.252	11.665	7.636	9.883	2.526	3.078	3.000
2004	85.722	26.065	2.855	1.196	12.510	8.704	10.004	2.297	2.731	1.600
2005	85.869	21.778	3.091	0.472	9.398	7.468	7.881	2.773	3.270	0.700
2006	81.513	18.050	3.241	0.485	11.984	6.578	5.524	2.520	3.227	0.400
2007	92.724	13.488	2.512	3.021	16.145	3.757	6.350	2.522	2.522	0.400
2008	85.538	13.191	2.255	0.809	13.838	4.316	5.496	1.937	1.893	0.231
2009	68.202	10.895	2.410	1.069	12.296	4.806	5.639	2.828	2.520	0.265
2010	69.709	15.457	2.394	1.527	10.186	4.055	5.472	3.086	3.024	0.275
2011	76.576	17.904	2.522	0.140	15.673	4.086	6.013	3.521	3.047	0.186
2012	81.411	16.542	4.358	0.306	12.928	4.584	3.223	2.570	1.737	0.008
2013	74.341	28.859	6.056	0.060	8.761	4.475	2.920	2.606	1.308	0.000
2014	73.251	40.863	6.879	0.008	9.672	6.579	2.965	2.123	0.315	0.002
2015	77.521	31.713	5.223	0.021	12.728	4.067	3.077	2.935	0.064	0.001
2016	92.242	18.641	2.806	0.001	14.797	2.851	3.973	4.360	0.002	0.001

Table App.A.2: GLM standardized CPUE data for *M. paradoxus* and *M. capensis*, corresponding to the Model A6b species splitting algorithm (MARAM/IWS/2018/Hake/BG6).

	GLM CPUE (kg min^{-1})			
	M. paradoxus		*M. capensis*	
Year	West Coast	South Coast	West Coast	South Coast
1978	8.74	1.41	2.33	4.05
1979	8.78	1.13	3.22	4.50
1980	8.22	2.13	2.88	5.49
1981	8.06	1.33	3.02	4.73
1982	7.87	2.01	2.61	4.98
1983	8.73	2.03	3.27	5.85
1984	8.94	2.25	3.33	6.81
1985	10.51	3.04	3.73	8.56
1986	9.08	3.08	3.09	7.03
1987	7.58	2.83	2.61	6.46
1988	7.37	2.27	2.38	6.59
1989	8.00	2.37	2.56	7.34
1990	8.47	3.13	2.29	8.84
1991	9.45	3.47	2.76	7.90
1992	8.41	3.86	3.16	7.43
1993	8.49	3.20	3.05	5.44
1994	9.09	2.84	3.57	6.52
1995	8.06	2.11	3.42	5.95
1996	8.86	3.18	3.92	6.02
1997	7.86	3.43	3.32	5.01
1998	8.95	3.24	3.79	4.95
1999	7.35	3.83	3.38	5.34
2000	6.62	2.90	3.15	5.92
2001	5.32	2.86	2.25	4.45
2002	5.21	2.56	2.14	4.75
2003	5.99	3.01	1.92	5.15
2004	4.91	2.50	1.79	4.27
2005	4.78	2.17	1.36	3.66
2006	5.05	2.28	1.55	2.89
2007	6.15	2.40	1.62	2.83
2008	6.78	2.48	2.01	3.73
2009	7.00	2.95	2.98	6.42
2010	7.85	3.25	2.68	5.18
2011	7.63	3.83	3.13	5.90
2012	6.56	3.35	2.59	3.91
2013	6.57	3.73	2.67	3.91
2014	6.68	3.43	2.21	2.83
2015	8.67	3.36	2.73	2.84
2016	8.80	3.47	2.77	3.74

Table App.A.3: Survey abundance estimates and associated standard errors in thousand tons for *M. paradoxus* for the depth range 0-500m for the South Coast and for the West Coast (Fairweather, 2016a). Values in bold are for the surveys conducted by the *Africana* with the new gear, while underlined values are for the surveys conducted by the *Andromeda* and in 2016 by the *Compass Challenger*.

	West coast				South coast			
Year	Summer		Winter		Spring (Sept)		Autumn (Apr/May)	
	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)
1985	168.989	(37.765)	290.281	(63.295)	-	-	-	-
1986	202.334	(37.745)	147.378	(21.667)	11.280	(3.111)	-	-
1987	284.434	(54.165)	180.158	(39.047)	16.381	(3.033)	-	-
1988	138.534	(20.303)	252.121	(71.246)	-	-	28.293	(8.673)
1989	-	-	434.092	(142.716)	-	-	-	-
1990	307.615	(87.841)	205.704	(43.607)	-	-	-	-
1991	331.177	(81.633)	-	-	-	-	27.570	(8.153)
1992	225.755	(33.711)	-	-	-	-	25.036	(6.650)
1993	340.079	(51.427)	-	-	-	-	162.375	(81.691)
1994	333.499	(56.259)	-	-	-	-	108.179	(38.369)
1995	317.104	(76.709)	-	-	-	-	70.890	(39.330)
1996	474.270	(92.744)	-	-	-	-	68.859	(19.929)
1997	543.615	(96.043)	-	-	-	-	121.707	(51.507)
1998	-	-	-	-	-	-	-	-
1999	542.830	(110.541)	-	-	-	-	263.256	(59.439)
2000	-	-	-	-	-	-	-	-
2001	-	-	-	-	16.668	(7.159)	-	-
2002	251.820	(32.690)	-	-	-	-	-	-
2003	386.321	(63.565)	-	-	**98.434**	(42.249)	185.345	(82.188)
2004	**271.540**	(55.710)	-	-	**70.001**	(22.156)	**39.822**	(22.153)
2005	**296.065**	(42.409)	-	-	-	-	**26.691**	(6.017)
2006	316.247	(57.332)	-	-	68.507	(18.283)	34.868	(5.843)
2007	**407.377**	(77.222)	-	-	**66.267**	(21.966)	**102.195**	(53.688)
2008	**238.143**	(37.018)	-	-	**25.661**	(8.324)	**33.034**	(9.340)
2009	**310.760**	(27.768)	-	-	-	-	**45.030**	(15.551)
2010	576.848	(88.202)	-	-	-	-	46.938	(12.160)
2011	**380.185**	(128.013)	-	-	-	-	**21.054**	(6.531)
2012	**405.865**	(59.099)	-	-	-	-	-	-
2013	136.260	(25.116)	-	-	-	-	-	-
2014	269.482	(37.492)	-	-	-	-	62.925	(24.802)
2015	207.583	(24.057)	-	-	-	-	111.411	(51.852)
2016	312.876	(33.250)	-	-	-	-	94.177	(51.731)
2017	319.024	(58.766)	-	-	-	-	-	-

Table App.A.4: Survey abundance estimates and associated standard errors in thousand tons for *M. capensis* for the depth range 0-500m for the South Coast and for the West Coast (Fairweather, 2016a). Values in bold are for the surveys conducted by the *Africana* with the new gear, while underlined values are for the surveys conducted by the *Andromeda* and in 2016 by the *Compass Challenger*.

	West coast				South coast			
Year	Summer		Winter		Spring (Sept)		Autumn (Apr/May)	
	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)
1985	102.929	(18.888)	159.198	(18.982)	-	-	-	-
1986	113.154	(23.474)	115.218	(19.733)	96.768	(10.737)	-	-
1987	75.438	(9.709)	83.050	(10.306)	137.008	(13.057)	-	-
1988	66.365	(9.930)	48.046	(9.574)	-	-	154.548	(23.984)
1989	-	-	294.740	(67.495)	-	-	-	-
1990	400.142	(97.102)	156.337	(22.507)	-	-	-	-
1991	67.565	(9.656)	-	-	-	-	276.607	(25.274)
1992	95.401	(11.892)	-	-	-	-	124.495	(13.600)
1993	93.613	(14.390)	-	-	-	-	144.551	(12.379)
1994	124.497	(37.845)	-	-	-	-	153.790	(20.310)
1995	193.292	(24.270)	-	-	-	-	222.464	(31.245)
1996	87.969	(9.866)	-	-	-	-	222.176	(23.144)
1997	252.606	(42.721)	-	-	-	-	163.163	(17.274)
1998	-	-	-	-	-	-	-	-
1999	188.624	(31.362)	-	-	-	-	171.946	(13.330)
2000	-	-	-	-	-	-	-	-
2001	-	-	-	-	117.590	(20.093)	-	-
2002	105.093	(16.130)	-	-	-	-	-	-
2003	73.020	(12.518)	-	-	**73.604**	(9.142)	117.538	(17.192)
2004	**194.294**	(30.714)	-	-	**96.933**	(13.936)	**92.796**	(11.318)
2005	**63.363**	(11.498)	-	-	-	-	**68.672**	(5.302)
2006	73.655	(17.255)	-	-	92.831	(8.998)	116.298	(11.931)
2007	**73.230**	(9.306)	-	-	**67.937**	(6.553)	**65.935**	(5.303)
2008	**52.577**	(7.069)	-	-	**87.836**	(9.723)	**102.169**	(9.681)
2009	**140.437**	(26.486)	-	-	-	-	**111.191**	(10.832)
2010	162.402	(34.891)	-	-	-	-	170.261	(33.235)
2011	**89.095**	(23.574)	-	-	-	-	**105.424**	(10.688)
2012	**84.746**	(8.331)	-	-	-	-	-	-
2013	30.383	(4.575)	-	-	-	-	-	-
2014	219.756	(60.342)	-	-	-	-	63.389	(6.415)
2015	65.086	(9.178)	-	-	-	-	76.059	(6.873)
2016	115.058	(30.400)	-	-	-	-	83.197	(6.600)
2017	69.289	(14.486)	-	-	-	-	-	-

Table App.A.5a: West coast commercial offshore trawl, species combined, sex-aggregated, catch-at-length data given as proportions (Fairweather, 2016b). Here and below, the blue bars represent the sizes of the proportions, with the shortest bar representing the lowest proportion in the matrix and the longest bar representing the highest proportion.

West coast offshore trawl, species combined

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1981	0.006	0.026	0.059	0.119	0.168	0.159	0.120	0.086	0.065	0.047	0.031	0.023	0.019	0.013	0.011	0.009	0.007	0.006	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.001
1982	0.003	0.025	0.076	0.120	0.153	0.166	0.130	0.093	0.059	0.046	0.028	0.018	0.015	0.012	0.012	0.010	0.008	0.006	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
1983	0.000	0.005	0.018	0.054	0.088	0.104	0.126	0.127	0.110	0.087	0.065	0.044	0.034	0.028	0.024	0.020	0.015	0.012	0.009	0.007	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
1984	0.000	0.003	0.009	0.057	0.113	0.127	0.139	0.111	0.092	0.082	0.062	0.036	0.029	0.025	0.023	0.019	0.014	0.010	0.009	0.008	0.007	0.006	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.001
1985	0.000	0.000	0.001	0.004	0.015	0.043	0.115	0.146	0.132	0.119	0.096	0.071	0.052	0.036	0.029	0.025	0.018	0.017	0.014	0.013	0.011	0.009	0.007	0.006	0.005	0.005	0.004	0.003	0.002	0.001	0.001	0.001
1986	0.000	0.000	0.002	0.008	0.029	0.050	0.094	0.136	0.147	0.134	0.111	0.075	0.050	0.033	0.026	0.019	0.015	0.011	0.009	0.008	0.006	0.006	0.006	0.005	0.005	0.004	0.004	0.003	0.002	0.001	0.001	0.002
1987	0.000	0.000	0.004	0.027	0.071	0.119	0.140	0.137	0.107	0.072	0.058	0.046	0.039	0.036	0.029	0.026	0.019	0.016	0.012	0.010	0.008	0.006	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001
1988	0.000	0.000	0.009	0.036	0.107	0.141	0.157	0.129	0.102	0.074	0.050	0.038	0.028	0.020	0.017	0.015	0.012	0.011	0.009	0.009	0.007	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.000	0.000	0.001
1989	0.000	0.003	0.018	0.055	0.115	0.158	0.161	0.122	0.088	0.065	0.045	0.033	0.026	0.020	0.017	0.013	0.010	0.008	0.007	0.007	0.006	0.006	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000
1990	0.000	0.001	0.005	0.013	0.058	0.106	0.131	0.141	0.127	0.115	0.081	0.055	0.042	0.030	0.023	0.016	0.011	0.010	0.007	0.006	0.004	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000
1991	0.000	0.001	0.006	0.022	0.049	0.077	0.092	0.099	0.088	0.088	0.075	0.066	0.063	0.052	0.041	0.032	0.024	0.019	0.014	0.014	0.011	0.012	0.011	0.010	0.008	0.007	0.005	0.004	0.003	0.002	0.001	0.002
1992	0.000	0.002	0.010	0.041	0.092	0.122	0.124	0.107	0.082	0.068	0.053	0.045	0.036	0.031	0.032	0.026	0.023	0.023	0.017	0.015	0.011	0.009	0.007	0.006	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.001
1993	0.000	0.001	0.003	0.015	0.041	0.075	0.095	0.085	0.071	0.069	0.073	0.064	0.065	0.063	0.066	0.051	0.038	0.034	0.023	0.019	0.012	0.009	0.006	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
1994	0.000	0.000	0.001	0.005	0.027	0.077	0.118	0.131	0.080	0.080	0.069	0.053	0.042	0.042	0.044	0.046	0.046	0.041	0.029	0.021	0.012	0.011	0.006	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
1995	0.000	0.003	0.019	0.035	0.054	0.071	0.122	0.118	0.119	0.109	0.085	0.048	0.032	0.036	0.023	0.013	0.016	0.015	0.014	0.015	0.014	0.010	0.009	0.006	0.004	0.003	0.003	0.001	0.001	0.000	0.000	0.001
1996	0.000	0.004	0.017	0.043	0.057	0.096	0.116	0.121	0.110	0.097	0.082	0.062	0.042	0.031	0.021	0.019	0.011	0.012	0.009	0.009	0.008	0.007	0.005	0.005	0.003	0.003	0.002	0.001	0.001	0.001	0.000	0.001
1997	0.000	0.003	0.018	0.040	0.060	0.096	0.130	0.118	0.111	0.097	0.080	0.052	0.036	0.033	0.021	0.014	0.012	0.013	0.011	0.012	0.010	0.008	0.007	0.005	0.003	0.003	0.002	0.001	0.001	0.000	0.000	0.001
1998	0.000	0.002	0.012	0.028	0.045	0.073	0.112	0.119	0.120	0.109	0.088	0.060	0.043	0.039	0.025	0.017	0.015	0.016	0.014	0.015	0.012	0.010	0.008	0.005	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.001
1999	0.000	0.002	0.011	0.026	0.044	0.076	0.116	0.117	0.115	0.103	0.084	0.056	0.040	0.037	0.025	0.018	0.017	0.018	0.016	0.017	0.015	0.012	0.010	0.007	0.005	0.004	0.004	0.002	0.001	0.001	0.001	0.001
2005	0.000	0.000	0.008	0.068	0.172	0.170	0.150	0.116	0.064	0.042	0.026	0.020	0.024	0.021	0.022	0.016	0.012	0.012	0.011	0.010	0.008	0.007	0.005	0.005	0.003	0.003	0.002	0.001	0.001	0.000	0.000	0.001
2006	0.000	0.001	0.008	0.038	0.075	0.116	0.146	0.144	0.137	0.095	0.041	0.031	0.024	0.022	0.019	0.017	0.015	0.014	0.012	0.010	0.006	0.006	0.005	0.005	0.003	0.003	0.002	0.002	0.001	0.001	0.000	0.001
2007	0.000	0.000	0.002	0.015	0.062	0.115	0.157	0.167	0.141	0.099	0.048	0.028	0.022	0.022	0.020	0.019	0.015	0.014	0.013	0.010	0.007	0.006	0.004	0.004	0.002	0.002	0.002	0.002	0.001	0.000	0.000	0.001
2008	0.000	0.000	0.000	0.004	0.023	0.060	0.111	0.155	0.129	0.107	0.085	0.044	0.050	0.043	0.029	0.026	0.028	0.023	0.019	0.015	0.012	0.009	0.008	0.007	0.004	0.003	0.002	0.002	0.002	0.001	0.000	0.001
2009	0.000	0.001	0.008	0.024	0.050	0.095	0.103	0.122	0.103	0.072	0.047	0.043	0.047	0.036	0.036	0.039	0.037	0.032	0.025	0.019	0.015	0.011	0.011	0.008	0.005	0.003	0.003	0.002	0.002	0.001	0.000	0.001
2010	0.000	0.002	0.002	0.005	0.018	0.067	0.131	0.137	0.112	0.090	0.063	0.045	0.043	0.045	0.047	0.045	0.032	0.031	0.019	0.016	0.012	0.010	0.007	0.007	0.004	0.004	0.003	0.002	0.002	0.001	0.000	0.001
2011	0.000	0.005	0.002	0.002	0.014	0.056	0.101	0.125	0.117	0.112	0.087	0.060	0.052	0.044	0.041	0.036	0.024	0.023	0.019	0.016	0.012	0.012	0.009	0.008	0.005	0.004	0.004	0.003	0.002	0.001	0.001	0.001
2012	0.000	0.003	0.007	0.015	0.028	0.080	0.117	0.096	0.097	0.088	0.067	0.063	0.061	0.050	0.047	0.041	0.033	0.028	0.018	0.015	0.011	0.009	0.007	0.005	0.004	0.003	0.003	0.002	0.001	0.001	0.001	0.001
2013	0.000	0.003	0.005	0.010	0.026	0.060	0.090	0.099	0.087	0.075	0.064	0.066	0.058	0.055	0.055	0.053	0.048	0.040	0.028	0.024	0.015	0.013	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
2014	0.000	0.001	0.004	0.015	0.071	0.106	0.131	0.124	0.104	0.060	0.055	0.040	0.033	0.039	0.044	0.041	0.030	0.023	0.018	0.016	0.012	0.008	0.007	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.002
2015	0.002	0.005	0.017	0.033	0.097	0.165	0.138	0.102	0.100	0.088	0.050	0.028	0.027	0.021	0.027	0.025	0.020	0.018	0.013	0.008	0.004	0.004	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000

Table App.A.5b: South coast commercial offshore trawl, species combined, sex-aggregated, catch-at-length data (Fairweather, 2016b).

South coast offshore trawl, species combined

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1975	0.000	0.000	0.000	0.002	0.009	0.021	0.046	0.055	0.047	0.056	0.045	0.066	0.068	0.068	0.075	0.067	0.068	0.055	0.055	0.044	0.031	0.024	0.016	0.013	0.013	0.011	0.006	0.006	0.005	0.005	0.005	0.016
1976	0.000	0.005	0.007	0.017	0.036	0.113	0.208	0.166	0.113	0.066	0.033	0.050	0.037	0.033	0.040	0.032	0.018	0.008	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
1977	0.000	0.000	0.000	0.002	0.003	0.015	0.045	0.050	0.058	0.072	0.073	0.078	0.068	0.061	0.042	0.036	0.030	0.026	0.026	0.022	0.022	0.024	0.018	0.011	0.009	0.061	0.044	0.035	0.045	0.021	0.001	0.002
1978	0.000	0.003	0.007	0.027	0.063	0.138	0.157	0.138	0.104	0.077	0.052	0.040	0.032	0.026	0.027	0.020	0.016	0.014	0.010	0.007	0.007	0.007	0.004	0.005	0.003	0.002	0.003	0.002	0.002	0.001	0.002	0.004
1979	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.013	0.036	0.053	0.056	0.048	0.050	0.049	0.063	0.079	0.081	0.063	0.069	0.058	0.050	0.040	0.034	0.027	0.029	0.020	0.019	0.014	0.010	0.008	0.007	0.018
1980	0.000	0.000	0.004	0.017	0.052	0.084	0.113	0.111	0.101	0.077	0.070	0.060	0.053	0.045	0.037	0.030	0.027	0.019	0.015	0.014	0.014	0.010	0.009	0.008	0.007	0.005	0.005	0.004	0.003	0.002	0.002	0.004
1981	0.000	0.001	0.006	0.021	0.041	0.098	0.119	0.107	0.107	0.071	0.078	0.065	0.055	0.041	0.039	0.030	0.025	0.020	0.016	0.012	0.012	0.009	0.006	0.005	0.003	0.003	0.003	0.002	0.001	0.001	0.001	0.002
1982	0.001	0.004	0.012	0.025	0.054	0.097	0.108	0.092	0.078	0.058	0.055	0.055	0.045	0.037	0.036	0.036	0.030	0.027	0.024	0.022	0.021	0.019	0.015	0.012	0.009	0.007	0.006	0.005	0.004	0.003	0.002	0.003
1983	0.000	0.001	0.003	0.019	0.046	0.076	0.081	0.090	0.108	0.094	0.080	0.053	0.045	0.039	0.042	0.037	0.036	0.031	0.023	0.019	0.017	0.015	0.012	0.010	0.007	0.005	0.003	0.003	0.002	0.002	0.001	0.002
1984	0.001	0.002	0.013	0.031	0.096	0.126	0.142	0.106	0.075	0.055	0.056	0.043	0.042	0.034	0.026	0.021	0.018	0.019	0.017	0.014	0.011	0.010	0.008	0.007	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.002
1985	0.000	0.000	0.001	0.004	0.025	0.063	0.112	0.117	0.104	0.101	0.086	0.060	0.047	0.034	0.029	0.028	0.025	0.026	0.023	0.020	0.017	0.013	0.013	0.013	0.009	0.007	0.007	0.006	0.004	0.003	0.001	0.004
1986	0.000	0.000	0.000	0.002	0.011	0.044	0.102	0.100	0.105	0.069	0.083	0.064	0.062	0.050	0.042	0.037	0.029	0.028	0.026	0.024	0.025	0.021	0.016	0.016	0.010	0.007	0.008	0.007	0.004	0.004	0.001	0.003
1987	0.000	0.000	0.001	0.004	0.033	0.084	0.118	0.125	0.090	0.074	0.054	0.037	0.037	0.038	0.038	0.036	0.032	0.029	0.030	0.025	0.023	0.021	0.017	0.012	0.009	0.008	0.007	0.006	0.004	0.003	0.002	0.004
1988	0.000	0.001	0.005	0.026	0.045	0.081	0.102	0.113	0.110	0.070	0.049	0.041	0.043	0.040	0.038	0.036	0.027	0.026	0.026	0.020	0.022	0.019	0.014	0.014	0.009	0.007	0.005	0.003	0.002	0.002	0.001	0.002
1989	0.000	0.002	0.003	0.020	0.084	0.132	0.171	0.130	0.071	0.063	0.047	0.037	0.033	0.023	0.021	0.016	0.020	0.023	0.016	0.017	0.015	0.016	0.012	0.010	0.007	0.004	0.003	0.002	0.001	0.001	0.001	0.000
1990	0.000	0.001	0.004	0.010	0.040	0.073	0.087	0.100	0.092	0.104	0.095	0.076	0.061	0.051	0.040	0.029	0.023	0.022	0.016	0.015	0.011	0.011	0.009	0.008	0.007	0.005	0.004	0.002	0.002	0.001	0.001	0.001
1991	0.000	0.001	0.005	0.020	0.047	0.081	0.108	0.121	0.108	0.100	0.077	0.061	0.051	0.042	0.031	0.023	0.018	0.017	0.014	0.013	0.010	0.010	0.009	0.007	0.006	0.005	0.003	0.003	0.002	0.001	0.001	0.001
1992	0.000	0.001	0.005	0.021	0.048	0.070	0.086	0.106	0.107	0.105	0.089	0.078	0.055	0.043	0.035	0.025	0.019	0.018	0.014	0.014	0.010	0.010	0.008	0.007	0.007	0.005	0.004	0.003	0.002	0.002	0.001	0.002
1993	0.000	0.001	0.004	0.022	0.054	0.088	0.105	0.104	0.098	0.094	0.094	0.068	0.053	0.038	0.033	0.024	0.018	0.017	0.013	0.013	0.010	0.009	0.008	0.006	0.006	0.005	0.004	0.003	0.002	0.001	0.001	0.002
1994	0.000	0.001	0.002	0.013	0.038	0.082	0.116	0.139	0.104	0.098	0.077	0.055	0.038	0.033	0.031	0.027	0.026	0.023	0.018	0.015	0.010	0.011	0.008	0.007	0.007	0.006	0.006	0.004	0.003	0.002	0.001	0.002
1995	0.000	0.001	0.011	0.021	0.044	0.061	0.111	0.133	0.129	0.108	0.073	0.042	0.036	0.040	0.022	0.012	0.012	0.014	0.012	0.019	0.016	0.015	0.015	0.013	0.011	0.009	0.009	0.005	0.004	0.002	0.002	0.002
1996	0.000	0.000	0.002	0.004	0.022	0.050	0.101	0.122	0.142	0.141	0.108	0.080	0.047	0.032	0.023	0.018	0.013	0.015	0.014	0.013	0.010	0.009	0.007	0.006	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.002
2008	0.000	0.000	0.001	0.005	0.014	0.069	0.130	0.161	0.137	0.097	0.053	0.042	0.035	0.035	0.036	0.034	0.031	0.031	0.023	0.018	0.014	0.009	0.006	0.006	0.003	0.003	0.002	0.002	0.002	0.000	0.000	0.001
2009	0.000	0.000	0.000	0.005	0.028	0.073	0.099	0.114	0.096	0.076	0.060	0.053	0.055	0.048	0.044	0.038	0.035	0.039	0.031	0.029	0.015	0.015	0.011	0.007	0.006	0.005	0.004	0.004	0.004	0.001	0.001	0.002
2010	0.000	0.000	0.000	0.001	0.008	0.035	0.083	0.106	0.109	0.086	0.076	0.053	0.052	0.052	0.047	0.043	0.039	0.035	0.032	0.030	0.023	0.023	0.017	0.013	0.010	0.009	0.005	0.005	0.004	0.002	0.001	0.002
2011	0.000	0.000	0.001	0.003	0.009	0.040	0.086	0.119	0.117	0.095	0.071	0.054	0.055	0.050	0.038	0.041	0.037	0.036	0.028	0.026	0.018	0.017	0.014	0.011	0.009	0.008	0.005	0.004	0.003	0.002	0.002	0.002
2012	0.000	0.000	0.000	0.004	0.013	0.036	0.075	0.101	0.101	0.151	0.077	0.056	0.052	0.042	0.042	0.038	0.031	0.033	0.026	0.024	0.019	0.019	0.015	0.012	0.008	0.007	0.005	0.004	0.003	0.003	0.002	0.003
2013	0.000	0.000	0.001	0.006	0.022	0.064	0.126	0.164	0.139	0.088	0.065	0.043	0.038	0.038	0.037	0.031	0.027	0.029	0.018	0.016	0.011	0.007	0.006	0.004	0.004	0.003	0.003	0.003	0.002	0.001	0.001	0.001
2014	0.000	0.000	0.009	0.020	0.079	0.102	0.123	0.135	0.120	0.103	0.041	0.037	0.037	0.030	0.029	0.028	0.023	0.019	0.023	0.012	0.006	0.006	0.004	0.002	0.002	0.002	0.002	0.002	0.001	0.000	0.001	0.001

Table App.A.5c: South coast commercial inshore trawl, *M. capensis*, sex-aggregated, catch-at-length data (Fairweather, 2016b).

South coast inshore trawl, *M. capensis*

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1981	0.000	0.000	0.000	0.001	0.003	0.014	0.037	0.070	0.101	0.117	0.119	0.103	0.094	0.075	0.060	0.049	0.036	0.031	0.021	0.017	0.015	0.011	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.000
1982	0.000	0.000	0.000	0.001	0.006	0.031	0.085	0.133	0.144	0.125	0.112	0.088	0.067	0.052	0.038	0.029	0.023	0.016	0.012	0.010	0.007	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000	0.000	0.004	0.018	0.040	0.066	0.084	0.092	0.097	0.102	0.105	0.096	0.080	0.061	0.046	0.032	0.022	0.015	0.011	0.008	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.000	0.001
1984	0.000	0.000	0.000	0.000	0.001	0.003	0.017	0.050	0.086	0.114	0.132	0.139	0.121	0.083	0.058	0.043	0.035	0.028	0.022	0.018	0.016	0.012	0.009	0.006	0.004	0.002	0.001	0.001	0.001	0.000	0.000	0.001
1985	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.016	0.036	0.055	0.068	0.083	0.100	0.116	0.106	0.097	0.087	0.063	0.045	0.032	0.025	0.020	0.014	0.010	0.006	0.004	0.003	0.002	0.001	0.001	0.000	0.001
1986	0.000	0.000	0.000	0.000	0.001	0.005	0.019	0.048	0.081	0.102	0.096	0.090	0.072	0.067	0.059	0.054	0.055	0.052	0.047	0.042	0.036	0.025	0.017	0.011	0.007	0.004	0.003	0.002	0.001	0.001	0.001	0.001
1987	0.000	0.000	0.000	0.000	0.000	0.003	0.010	0.029	0.061	0.099	0.110	0.136	0.113	0.086	0.065	0.055	0.046	0.040	0.031	0.026	0.025	0.023	0.014	0.010	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.001
1988	0.000	0.000	0.000	0.001	0.006	0.021	0.051	0.093	0.097	0.093	0.085	0.082	0.081	0.069	0.062	0.052	0.047	0.036	0.031	0.024	0.021	0.019	0.010	0.007	0.005	0.003	0.002	0.001	0.001	0.001	0.000	0.001
1989	0.000	0.000	0.000	0.002	0.008	0.024	0.051	0.082	0.097	0.102	0.102	0.099	0.080	0.065	0.055	0.052	0.040	0.032	0.024	0.023	0.018	0.016	0.009	0.006	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000
1990	0.000	0.000	0.000	0.001	0.003	0.010	0.024	0.048	0.064	0.075	0.095	0.106	0.111	0.089	0.078	0.068	0.053	0.040	0.032	0.029	0.022	0.016	0.012	0.008	0.005	0.004	0.002	0.002	0.001	0.001	0.000	0.001
1991	0.000	0.000	0.000	0.001	0.003	0.010	0.023	0.043	0.065	0.075	0.075	0.077	0.080	0.085	0.083	0.077	0.067	0.059	0.044	0.039	0.028	0.021	0.015	0.011	0.007	0.005	0.003	0.002	0.001	0.001	0.001	0.001
1992	0.000	0.000	0.002	0.006	0.015	0.035	0.058	0.077	0.082	0.083	0.082	0.074	0.073	0.066	0.063	0.055	0.051	0.043	0.033	0.030	0.023	0.017	0.011	0.007	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001
1993	0.000	0.000	0.000	0.002	0.005	0.014	0.031	0.066	0.070	0.079	0.092	0.111	0.122	0.094	0.070	0.060	0.049	0.034	0.023	0.022	0.019	0.013	0.008	0.005	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000
1994	0.000	0.000	0.001	0.003	0.010	0.032	0.046	0.073	0.084	0.084	0.077	0.073	0.069	0.061	0.058	0.066	0.052	0.039	0.036	0.035	0.031	0.025	0.017	0.010	0.006	0.004	0.002	0.002	0.001	0.000	0.000	0.000
1995	0.000	0.000	0.000	0.001	0.005	0.015	0.036	0.048	0.079	0.091	0.091	0.093	0.090	0.084	0.072	0.065	0.053	0.040	0.028	0.024	0.020	0.018	0.014	0.011	0.009	0.006	0.004	0.002	0.001	0.000	0.000	0.000
1996	0.000	0.000	0.001	0.002	0.008	0.021	0.062	0.078	0.095	0.130	0.117	0.089	0.092	0.065	0.051	0.048	0.035	0.024	0.019	0.016	0.013	0.012	0.009	0.006	0.004	0.003	0.002	0.001	0.000	0.000	0.000	0.000
1998	0.000	0.000	0.000	0.001	0.004	0.022	0.056	0.082	0.146	0.132	0.105	0.076	0.064	0.063	0.049	0.045	0.037	0.027	0.022	0.015	0.012	0.011	0.007	0.008	0.006	0.004	0.003	0.002	0.001	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.001	0.005	0.014	0.037	0.066	0.078	0.118	0.124	0.098	0.092	0.080	0.066	0.052	0.035	0.034	0.020	0.021	0.012	0.011	0.008	0.008	0.007	0.006	0.005	0.003	0.001	0.000	0.000	0.001
2000	0.000	0.000	0.000	0.000	0.004	0.009	0.029	0.064	0.085	0.108	0.117	0.106	0.096	0.079	0.075	0.059	0.046	0.034	0.022	0.018	0.010	0.010	0.008	0.006	0.005	0.004	0.004	0.002	0.001	0.000	0.000	0.000
2001	0.000	0.000	0.000	0.001	0.004	0.015	0.049	0.095	0.137	0.131	0.109	0.080	0.064	0.046	0.032	0.028	0.028	0.024	0.025	0.028	0.025	0.021	0.019	0.011	0.009	0.007	0.005	0.005	0.001	0.001	0.000	0.000
2006	0.000	0.000	0.000	0.001	0.002	0.016	0.052	0.118	0.183	0.132	0.122	0.063	0.055	0.043	0.031	0.030	0.024	0.020	0.019	0.020	0.020	0.014	0.013	0.006	0.004	0.003	0.003	0.001	0.000	0.001	0.000	0.001
2007	0.000	0.001	0.003	0.010	0.026	0.063	0.091	0.118	0.114	0.103	0.091	0.070	0.049	0.037	0.034	0.030	0.031	0.024	0.021	0.019	0.018	0.014	0.011	0.005	0.004	0.003	0.005	0.003	0.001	0.001	0.000	0.000
2008	0.000	0.002	0.002	0.007	0.025	0.067	0.093	0.091	0.100	0.090	0.083	0.070	0.058	0.046	0.041	0.039	0.034	0.032	0.025	0.025	0.020	0.016	0.013	0.007	0.005	0.004	0.003	0.001	0.001	0.001	0.000	0.001
2009	0.000	0.000	0.002	0.012	0.033	0.071	0.093	0.086	0.083	0.097	0.086	0.072	0.053	0.049	0.045	0.038	0.035	0.031	0.025	0.026	0.020	0.016	0.011	0.006	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000
2010	0.000	0.001	0.004	0.014	0.037	0.070	0.099	0.107	0.081	0.086	0.079	0.063	0.052	0.044	0.039	0.035	0.033	0.036	0.026	0.028	0.020	0.015	0.012	0.007	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000
2011	0.000	0.001	0.004	0.013	0.031	0.073	0.093	0.099	0.089	0.095	0.098	0.077	0.056	0.045	0.038	0.033	0.032	0.027	0.022	0.022	0.016	0.013	0.008	0.005	0.004	0.003	0.002	0.001	0.000	0.000	0.000	0.000
2012	0.001	0.002	0.005	0.017	0.038	0.070	0.097	0.108	0.095	0.083	0.081	0.069	0.055	0.048	0.044	0.035	0.027	0.027	0.021	0.021	0.016	0.013	0.010	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.001
2013	0.000	0.000	0.000	0.002	0.011	0.029	0.067	0.112	0.111	0.107	0.103	0.085	0.065	0.059	0.049	0.035	0.031	0.023	0.021	0.019	0.016	0.014	0.009	0.008	0.006	0.005	0.003	0.002	0.002	0.001	0.001	0.001
2014	0.000	0.000	0.000	0.002	0.009	0.019	0.056	0.092	0.125	0.092	0.100	0.101	0.085	0.062	0.047	0.043	0.039	0.032	0.019	0.015	0.013	0.008	0.008	0.008	0.006	0.003	0.004	0.003	0.002	0.002	0.001	0.003
2015	0.000	0.001	0.005	0.015	0.036	0.084	0.117	0.115	0.108	0.089	0.079	0.071	0.049	0.043	0.036	0.032	0.024	0.023	0.022	0.016	0.014	0.008	0.005	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000

Table App.A.5d: West coast longline, species combined, sex-aggregated, catch-at-length data.

West coast longline, species combined

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	79
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.007	0.008	0.010	0.014	0.019	0.027	0.035	0.040	0.044	0.049	0.055	0.068	0.078	0.080	0.084	0.080	0.071	0.061	0.157
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.002	0.005	0.009	0.018	0.022	0.044	0.042	0.053	0.064	0.057	0.075	0.071	0.076	0.083	0.062	0.069	0.060	0.185
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.003	0.005	0.008	0.014	0.021	0.032	0.046	0.058	0.065	0.088	0.083	0.083	0.086	0.075	0.071	0.061	0.052	0.144
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.003	0.007	0.011	0.015	0.027	0.028	0.046	0.047	0.046	0.060	0.068	0.076	0.072	0.078	0.079	0.070	0.067	0.051	0.145

Table App.A.5e: South coast longline, species combined, sex-aggregated, catch-at-length data.

South coast longline, *M. capensis*

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.007	0.012	0.022	0.035	0.055	0.069	0.082	0.082	0.090	0.083	0.079	0.078	0.066	0.060	0.045	0.037	0.026	0.069
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.002	0.005	0.009	0.018	0.022	0.044	0.042	0.053	0.064	0.057	0.075	0.071	0.076	0.083	0.062	0.069	0.060	0.185
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.011	0.016	0.031	0.043	0.038	0.048	0.056	0.069	0.075	0.087	0.090	0.093	0.089	0.070	0.059	0.045	0.076
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.012	0.017	0.027	0.033	0.043	0.044	0.052	0.064	0.076	0.086	0.089	0.088	0.084	0.077	0.066	0.048	0.085

Table App.A.5f: West coast longline, *M. paradoxus*, sex-disaggregated, catch-at-length data (Somhlaba and Leslie, 2014) (males in blue, females in pink).

West coast longline, *M. paradoxus*

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.003	0.004	0.006	0.006	0.006	0.013	0.018	0.034	0.034	0.045	0.072	0.080	0.095	0.104	0.095	0.097	0.085	0.068	0.059	0.042	0.030
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.002	0.002	0.003	0.007	0.016	0.020	0.033	0.049	0.074	0.093	0.114	0.110	0.104	0.097	0.089	0.062	0.056	0.040	0.024
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.003	0.003	0.008	0.013	0.023	0.048	0.075	0.084	0.076	0.080	0.068	0.065	0.056	0.074	0.082	0.064	0.057	0.032	0.031	0.034	0.008	0.016
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.006	0.011	0.019	0.029	0.043	0.057	0.069	0.077	0.095	0.106	0.107	0.098	0.084	0.069	0.054	0.040	0.027
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.003	0.004	0.008	0.014	0.027	0.028	0.041	0.059	0.070	0.074	0.074	0.071	0.072	0.068	0.088	0.076	0.066	0.061	0.052	0.040
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.003	0.008	0.012	0.022	0.030	0.044	0.067	0.078	0.086	0.093	0.092	0.088	0.089	0.082	0.071	0.058	0.046	0.027
2003	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.002	0.002	0.004	0.007	0.010	0.016	0.032	0.044	0.055	0.062	0.072	0.082	0.084	0.092	0.093	0.073	0.069	0.065	0.049	0.034	0.025	0.021
2003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.003	0.005	0.010	0.020	0.033	0.052	0.071	0.090	0.098	0.102	0.094	0.095	0.079	0.069	0.058	0.048	0.037	0.030
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.001	0.002	0.012	0.015	0.020	0.026	0.036	0.051	0.065	0.077	0.097	0.108	0.114	0.101	0.081	0.062	0.043	0.030	0.025	0.014	0.010	0.006
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.007	0.012	0.018	0.029	0.037	0.050	0.061	0.081	0.097	0.106	0.103	0.097	0.083	0.067	0.052	0.038	0.027	0.019	0.012
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.007	0.014	0.019	0.030	0.040	0.054	0.079	0.084	0.107	0.099	0.091	0.086	0.081	0.063	0.045	0.035	0.025	0.013	0.011	0.008	0.005
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.013	0.024	0.037	0.056	0.074	0.091	0.097	0.103	0.101	0.091	0.077	0.064	0.052	0.039	0.030	0.021	0.018
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.005	0.005	0.014	0.018	0.024	0.031	0.049	0.067	0.098	0.121	0.120	0.119	0.103	0.075	0.052	0.036	0.027	0.014	0.006	0.005	0.002	0.000
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.006	0.012	0.019	0.030	0.041	0.058	0.073	0.088	0.100	0.109	0.107	0.093	0.078	0.058	0.043	0.031	0.023	0.016	0.011
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.005	0.005	0.013	0.021	0.026	0.056	0.074	0.094	0.086	0.097	0.101	0.046	0.054	0.073	0.035	0.038	0.041	0.051	0.025	0.035	0.010	0.008
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.005	0.009	0.019	0.036	0.060	0.089	0.105	0.113	0.112	0.117	0.093	0.074	0.058	0.042	0.027	0.017	0.012	0.008
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.014	0.020	0.033	0.044	0.050	0.066	0.073	0.081	0.093	0.096	0.076	0.063	0.052	0.051	0.057	0.023	0.021	0.032	0.028	0.016	0.007
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.005	0.012	0.016	0.032	0.038	0.062	0.079	0.096	0.111	0.112	0.092	0.078	0.062	0.050	0.037	0.034	0.026	0.024	0.017	0.012
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.015	0.009	0.010	0.018	0.039	0.051	0.050	0.061	0.086	0.114	0.101	0.080	0.069	0.062	0.053	0.038	0.034	0.033	0.021	0.016	0.015	0.012	0.008
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.006	0.009	0.020	0.032	0.048	0.073	0.090	0.112	0.109	0.115	0.105	0.079	0.065	0.038	0.031	0.022	0.018	0.013	0.006	0.004
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.003	0.003	0.008	0.013	0.023	0.048	0.075	0.084	0.076	0.080	0.068	0.065	0.056	0.074	0.082	0.064	0.057	0.032	0.031	0.034	0.008	0.016
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.006	0.011	0.019	0.029	0.043	0.057	0.069	0.077	0.095	0.106	0.107	0.098	0.084	0.069	0.054	0.040	0.027

Table App.A.5g: West coast longline, *M. capensis*, sex-disaggregated, catch-at-length data (Somhlaba and Leslie, 2014) (males in blue, females in pink).

West coast longline, *M. capensis*

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.008	0.023	0.028	0.042	0.055	0.072	0.092	0.092	0.123	0.120	0.095	0.071	0.063	0.043	0.029	0.010	0.010	0.012	0.002
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.011	0.016	0.020	0.028	0.035	0.047	0.067	0.075	0.077	0.087	0.093	0.090	0.086	0.082	0.071	0.048	0.035	0.021
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.008	0.017	0.017	0.039	0.047	0.075	0.116	0.110	0.134	0.087	0.076	0.064	0.071	0.036	0.034	0.022	0.014	0.007	0.007	0.004
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.004	0.005	0.011	0.019	0.037	0.060	0.088	0.105	0.091	0.077	0.072	0.073	0.066	0.069	0.052	0.052	0.040	0.043	0.030
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.004	0.003	0.014	0.029	0.045	0.075	0.124	0.137	0.135	0.124	0.097	0.063	0.057	0.028	0.025	0.010	0.014	0.011
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.009	0.016	0.031	0.057	0.082	0.111	0.133	0.135	0.120	0.097	0.069	0.050	0.035	0.027	0.020
2003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.003	0.004	0.007	0.018	0.029	0.041	0.059	0.094	0.113	0.121	0.117	0.105	0.085	0.071	0.046	0.035	0.028	0.019
2003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.004	0.008	0.013	0.021	0.038	0.059	0.078	0.100	0.115	0.119	0.117	0.104	0.082	0.063	0.043	0.031
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.009	0.014	0.015	0.019	0.023	0.035	0.050	0.065	0.093	0.122	0.119	0.107	0.107	0.079	0.046	0.034	0.025	0.012	0.008	0.006	0.004
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.010	0.017	0.029	0.042	0.054	0.068	0.075	0.086	0.095	0.100	0.100	0.095	0.079	0.065	0.046	0.031
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.004	0.009	0.023	0.038	0.052	0.078	0.103	0.116	0.125	0.116	0.094	0.067	0.053	0.043	0.029	0.017	0.012	0.009	0.007
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.009	0.019	0.029	0.041	0.060	0.082	0.101	0.112	0.110	0.102	0.086	0.070	0.053	0.041	0.034	0.025	0.020
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.026	0.028	0.035	0.006	0.017	0.019	0.021	0.036	0.041	0.042	0.066	0.073	0.095	0.105	0.116	0.105	0.063	0.040	0.022	0.013	0.010	0.005	0.004	0.002
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.005	0.004	0.007	0.012	0.019	0.027	0.029	0.037	0.044	0.057	0.067	0.083	0.102	0.107	0.104	0.094	0.071	0.052	0.031	0.023	0.017
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.003	0.017	0.024	0.031	0.044	0.061	0.056	0.072	0.090	0.071	0.065	0.065	0.055	0.048	0.053	0.055	0.036	0.032	0.041	0.039	0.027	0.009
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.012	0.018	0.029	0.051	0.062	0.040	0.046	0.057	0.062	0.065	0.053	0.047	0.060	0.057	0.076	0.053	0.046	0.055	0.058	0.035	0.017
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.006	0.008	0.012	0.018	0.037	0.053	0.066	0.098	0.104	0.087	0.094	0.065	0.047	0.038	0.047	0.051	0.044	0.029	0.024	0.033	0.034
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.007	0.008	0.018	0.028	0.053	0.048	0.064	0.070	0.103	0.081	0.083	0.065	0.081	0.074	0.050	0.052	0.038	0.038	0.033
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.004	0.007	0.011	0.020	0.024	0.036	0.037	0.048	0.052	0.066	0.074	0.094	0.093	0.093	0.082	0.063	0.048	0.039	0.035	0.026	0.020	0.011	0.010
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.003	0.006	0.008	0.014	0.019	0.030	0.031	0.043	0.054	0.064	0.075	0.097	0.097	0.101	0.092	0.078	0.064	0.044	0.035	0.022	0.010	0.008
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.008	0.017	0.017	0.039	0.047	0.075	0.116	0.110	0.134	0.087	0.076	0.064	0.071	0.036	0.034	0.022	0.014	0.007	0.007	0.004
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.004	0.005	0.011	0.019	0.037	0.060	0.088	0.105	0.091	0.077	0.072	0.073	0.066	0.069	0.052	0.052	0.040	0.043	0.030

Table App.A.5h: South coast longline, *M. paradoxus*, sex-disaggregated, catch-at-length data (Somhlaba and Leslie, 2014) (males in blue, females in pink).

South coast longline, *M. paradoxus*

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
2001	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.005	0.005	0.000	0.005	0.005	0.000	0.015	0.031	0.015	0.051	0.071	0.071	0.097	0.051	0.097	0.102	0.026	0.061	0.077	0.051	0.036	0.051	0.026	0.036	0.010
2001	0.000	0.000	0.000	0.000	0.000	0.007	0.007	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.007	0.007	0.014	0.058	0.051	0.058	0.159	0.065	0.065	0.138	0.080	0.080	0.051	0.051	0.036	0.029	0.007
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.053	0.105	0.105	0.158	0.053	0.105	0.158	0.105	0.053	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.057	0.114	0.143	0.029	0.086	0.143	0.086	0.000	0.029	0.029	0.029	0.000	0.086	0.057	0.000	0.000	0.029	0.057	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.014	0.018	0.034	0.043	0.073	0.082	0.089	0.101	0.106	0.101	0.092	0.076	0.071	0.038	0.027	0.012	0.009	0.005	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.005	0.015	0.019	0.029	0.036	0.056	0.067	0.082	0.089	0.108	0.097	0.108	0.097	0.078	0.046	0.032	0.019	0.011	0.002	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.017	0.017	0.017	0.032	0.046	0.070	0.087	0.133	0.168	0.130	0.078	0.046	0.035	0.029	0.017	0.029	0.017	0.014	0.009	0.000	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.024	0.020	0.059	0.078	0.098	0.093	0.117	0.117	0.141	0.083	0.044	0.020	0.024	0.039	0.020	0.005	0.000	0.000	0.000	0.005	0.000
2010	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.005	0.005	0.000	0.005	0.005	0.000	0.015	0.031	0.015	0.051	0.071	0.071	0.097	0.051	0.097	0.102	0.026	0.061	0.077	0.051	0.036	0.051	0.026	0.036	0.010
2010	0.000	0.000	0.000	0.000	0.000	0.007	0.007	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.007	0.007	0.014	0.058	0.051	0.058	0.159	0.065	0.065	0.138	0.080	0.080	0.051	0.051	0.036	0.029	0.007

Table App.A.5i: South coast longline, *M. capensis*, sex-disaggregated, catch-at-length data (Somhlaba and Leslie, 2014) (males in blue, females in pink).

South coast longline, *M. capensis*

Length	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.008	0.023	0.028	0.042	0.055	0.072	0.092	0.092	0.123	0.120	0.095	0.071	0.063	0.043	0.029	0.010	0.010	0.012	0.002
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.004	0.007	0.011	0.020	0.024	0.036	0.037	0.048	0.052	0.066	0.074	0.094	0.093	0.093	0.082	0.063	0.048	0.039	0.035	0.026	0.020	0.011	0.010
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.008	0.017	0.017	0.039	0.047	0.075	0.116	0.110	0.134	0.087	0.076	0.064	0.071	0.036	0.034	0.022	0.014	0.007	0.007	0.004
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.008	0.017	0.017	0.039	0.047	0.075	0.116	0.110	0.134	0.087	0.076	0.064	0.071	0.036	0.034	0.022	0.014	0.007	0.007	0.004
2003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.004	0.003	0.014	0.029	0.045	0.075	0.124	0.137	0.135	0.124	0.097	0.063	0.057	0.028	0.025	0.010	0.014	0.011
2003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.011	0.016	0.020	0.028	0.035	0.047	0.067	0.075	0.077	0.087	0.093	0.090	0.086	0.082	0.071	0.048	0.035	0.021
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.003	0.004	0.007	0.018	0.029	0.041	0.059	0.094	0.113	0.121	0.117	0.105	0.085	0.071	0.046	0.035	0.028	0.019
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.004	0.005	0.011	0.019	0.037	0.060	0.088	0.105	0.091	0.077	0.072	0.073	0.066	0.069	0.052	0.052	0.040	0.043	0.030
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.009	0.014	0.015	0.019	0.023	0.035	0.050	0.065	0.093	0.122	0.119	0.107	0.107	0.079	0.046	0.034	0.025	0.012	0.008	0.006	0.004
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.009	0.016	0.031	0.057	0.082	0.111	0.133	0.135	0.120	0.097	0.069	0.050	0.035	0.027	0.020
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.004	0.009	0.023	0.038	0.052	0.078	0.103	0.116	0.125	0.116	0.094	0.067	0.053	0.043	0.029	0.017	0.012	0.009	0.007
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.004	0.008	0.013	0.021	0.038	0.059	0.078	0.100	0.115	0.119	0.117	0.104	0.082	0.063	0.043	0.031
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.026	0.028	0.035	0.006	0.017	0.019	0.021	0.036	0.041	0.042	0.066	0.073	0.095	0.105	0.116	0.105	0.063	0.040	0.022	0.013	0.010	0.005	0.004	0.002
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.010	0.017	0.029	0.042	0.054	0.068	0.075	0.086	0.095	0.100	0.100	0.095	0.079	0.065	0.046	0.031
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.003	0.017	0.024	0.031	0.044	0.061	0.056	0.072	0.090	0.071	0.065	0.065	0.055	0.048	0.053	0.055	0.036	0.032	0.041	0.039	0.027	0.009
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.009	0.019	0.029	0.041	0.060	0.082	0.101	0.112	0.110	0.102	0.086	0.070	0.053	0.041	0.034	0.025	0.020
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.006	0.008	0.012	0.018	0.037	0.053	0.066	0.098	0.104	0.087	0.094	0.065	0.047	0.038	0.047	0.051	0.044	0.029	0.024	0.033	0.034
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.005	0.004	0.007	0.012	0.019	0.027	0.029	0.037	0.044	0.057	0.067	0.083	0.102	0.107	0.104	0.094	0.071	0.052	0.031	0.023	0.017

Table App.A.6a: *M. paradoxus*, sex-aggregated, survey catch-at-length data (Fairweather, pers. commn).

West coast summer survey, *M. paradoxus*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1985	0.00000	0.00031	0.00000	0.00457	0.00806	0.01327	0.02576	0.04020	0.04483	0.12106	0.20238	0.14744	0.10008	0.07573	0.06070	0.03939	0.03413	0.02486	0.01530	0.01066
1986	0.00000	0.00006	0.00175	0.00365	0.00902	0.02429	0.03715	0.03630	0.04669	0.09489	0.16115	0.15381	0.09740	0.11350	0.09150	0.06050	0.02731	0.01408	0.00717	0.00459
1987	0.00000	0.00002	0.00005	0.00129	0.00264	0.01135	0.04476	0.05554	0.10294	0.20792	0.20276	0.14235	0.07185	0.04660	0.03174	0.02288	0.01839	0.01011	0.00809	0.00465
1988	0.00001	0.00053	0.00363	0.00497	0.01786	0.04870	0.10619	0.12251	0.12185	0.15656	0.09752	0.09912	0.06337	0.02878	0.01540	0.01164	0.00959	0.00524	0.00279	0.00191
1990	0.00041	0.00010	0.00130	0.00504	0.03056	0.03536	0.02454	0.07095	0.12422	0.13749	0.09623	0.08881	0.10740	0.10236	0.08127	0.04457	0.02167	0.01418	0.00487	0.00311
1991	0.00000	0.00008	0.00079	0.00289	0.01354	0.02904	0.05008	0.11043	0.20042	0.15843	0.11112	0.07726	0.07929	0.06074	0.03711	0.01693	0.01129	0.00783	0.00556	0.00524
1992	0.00006	0.00007	0.00029	0.00234	0.01058	0.02966	0.08974	0.14056	0.09617	0.09250	0.12145	0.12318	0.08766	0.05901	0.04181	0.02406	0.01250	0.00933	0.00840	0.00687
2002	0.00010	0.00015	0.00087	0.00290	0.01975	0.06554	0.10723	0.09360	0.09388	0.11805	0.12883	0.11387	0.07522	0.04273	0.03020	0.02328	0.01614	0.01118	0.00803	0.00633
2003	0.00005	0.00007	0.00071	0.00268	0.01340	0.03875	0.06436	0.09766	0.11144	0.10603	0.08999	0.11844	0.13283	0.09404	0.05696	0.02640	0.01385	0.00883	0.00457	0.00305
2004	0.00016	0.00242	0.02186	0.05532	0.07448	0.08952	0.05946	0.05963	0.09013	0.10745	0.09639	0.08084	0.06131	0.04208	0.03297	0.02080	0.01887	0.01544	0.01250	0.01006
2005	0.00033	0.00293	0.00849	0.01590	0.05008	0.11726	0.21686	0.16130	0.08240	0.07189	0.08773	0.05719	0.03437	0.02466	0.01975	0.01741	0.01149	0.00706	0.00337	0.00222

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1985	0.00662	0.00577	0.00390	0.00285	0.00252	0.00201	0.00164	0.00100	0.00067	0.00080	0.00055	0.00079	0.00079	0.00058	0.00023	0.00026	0.00012	0.00003	0.00015
1986	0.00266	0.00225	0.00156	0.00118	0.00100	0.00111	0.00064	0.00074	0.00080	0.00054	0.00069	0.00033	0.00046	0.00044	0.00032	0.00009	0.00008	0.00004	0.00027
1987	0.00363	0.00280	0.00209	0.00094	0.00065	0.00062	0.00087	0.00024	0.00015	0.00013	0.00022	0.00014	0.00020	0.00014	0.00005	0.00037	0.00042	0.00023	0.00018
1988	0.00201	0.00158	0.00145	0.00125	0.00235	0.00272	0.00770	0.01195	0.01383	0.01030	0.00985	0.00661	0.00336	0.00343	0.00136	0.00039	0.00026	0.00039	0.00102
1990	0.00134	0.00062	0.00082	0.00081	0.00030	0.00022	0.00059	0.00018	0.00013	0.00013	0.00009	0.00008	0.00011	0.00003	0.00004	0.00003	0.00001	0.00000	0.00001
1991	0.00446	0.00353	0.00266	0.00224	0.00180	0.00135	0.00115	0.00090	0.00068	0.00053	0.00050	0.00052	0.00040	0.00039	0.00030	0.00017	0.00015	0.00010	0.00007
1992	0.00607	0.00596	0.00412	0.00394	0.00481	0.00406	0.00374	0.00211	0.00210	0.00171	0.00088	0.00085	0.00095	0.00049	0.00052	0.00049	0.00027	0.00034	0.00036
2002	0.00551	0.00595	0.00563	0.00503	0.00375	0.00417	0.00345	0.00272	0.00150	0.00143	0.00072	0.00053	0.00044	0.00043	0.00021	0.00030	0.00013	0.00007	0.00014
2003	0.00229	0.00198	0.00155	0.00136	0.00120	0.00133	0.00127	0.00101	0.00090	0.00065	0.00059	0.00035	0.00041	0.00026	0.00022	0.00015	0.00013	0.00010	0.00013
2004	0.01014	0.00818	0.00574	0.00494	0.00424	0.00318	0.00260	0.00207	0.00199	0.00167	0.00122	0.00050	0.00069	0.00046	0.00014	0.00012	0.00016	0.00000	0.00027
2005	0.00153	0.00118	0.00081	0.00057	0.00056	0.00049	0.00047	0.00047	0.00024	0.00014	0.00015	0.00026	0.00012	0.00014	0.00005	0.00004	0.00002	0.00002	0.00003

West coast winter survey, *M. paradoxus*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1985	0.00002	0.00016	0.00027	0.00064	0.00366	0.00919	0.01344	0.02489	0.04497	0.05797	0.09081	0.09703	0.15245	0.16984	0.12576	0.06755	0.04486	0.02384	0.02869	0.01669
1986	0.00000	0.00024	0.00191	0.00570	0.01111	0.03655	0.09661	0.13539	0.08144	0.08140	0.08659	0.07415	0.08085	0.08065	0.05990	0.03237	0.02450	0.01746	0.01505	0.01307
1987	0.00000	0.00000	0.00029	0.00668	0.02197	0.04877	0.09608	0.12702	0.09892	0.07697	0.10340	0.10710	0.12243	0.07505	0.03242	0.02188	0.00971	0.01209	0.01026	0.00619
1988	0.00010	0.00140	0.00632	0.01097	0.01183	0.02269	0.06963	0.08640	0.06270	0.08363	0.11907	0.13749	0.13733	0.08841	0.03405	0.02277	0.01596	0.01742	0.01619	0.01507
1989	0.00002	0.00004	0.00048	0.00385	0.03391	0.08094	0.05281	0.03773	0.03393	0.04679	0.09659	0.11538	0.13440	0.13078	0.08120	0.05970	0.02816	0.01933	0.01524	0.00637
1990	0.00084	0.00002	0.00033	0.00271	0.03474	0.15335	0.18325	0.10310	0.08320	0.08440	0.06902	0.06714	0.05207	0.02778	0.01881	0.01663	0.01286	0.01203	0.00896	0.00654

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1985	0.00786	0.00470	0.00354	0.00195	0.00184	0.00160	0.00099	0.00075	0.00108	0.00061	0.00046	0.00054	0.00052	0.00014	0.00028	0.00012	0.00010	0.00010	0.00011
1986	0.00911	0.00699	0.00489	0.00446	0.00491	0.00365	0.00437	0.00354	0.00418	0.00422	0.00406	0.00263	0.00210	0.00178	0.00102	0.00103	0.00062	0.00047	0.00104
1987	0.00627	0.00334	0.00271	0.00230	0.00171	0.00143	0.00097	0.00096	0.00059	0.00047	0.00047	0.00022	0.00024	0.00035	0.00019	0.00012	0.00020	0.00013	0.00011
1988	0.01088	0.00754	0.00361	0.00375	0.00226	0.00212	0.00100	0.00237	0.00175	0.00116	0.00093	0.00095	0.00065	0.00018	0.00016	0.00054	0.00028	0.00016	0.00029
1989	0.00619	0.00339	0.00276	0.00219	0.00093	0.00091	0.00085	0.00099	0.00080	0.00068	0.00069	0.00086	0.00072	0.00029	0.00002	0.00002	0.00000	0.00000	0.00008
1990	0.00775	0.00437	0.00350	0.00353	0.00303	0.00491	0.00382	0.00419	0.00511	0.00573	0.00357	0.00461	0.00220	0.00263	0.00123	0.00055	0.00066	0.00017	0.00064

South coast spring survey, *M. paradoxus*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1986	0.00000	0.00000	0.00000	0.00188	0.02034	0.06658	0.03884	0.05365	0.04460	0.13680	0.23873	0.09506	0.03229	0.06155	0.07390	0.05072	0.03648	0.02206	0.01005	0.00669
1987	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00017	0.00175	0.00036	0.00030	0.00884	0.08836	0.23931	0.25666	0.13427	0.05751	0.03804	0.01734	0.02940	0.03915
2001	0.00000	0.00000	0.00000	0.00100	0.00311	0.00056	0.00000	0.00000	0.00000	0.00976	0.05636	0.13508	0.19423	0.25238	0.19624	0.09777	0.02718	0.00600	0.00493	0.00275
2003	0.00049	0.00011	0.00033	0.00199	0.00396	0.00299	0.00071	0.00069	0.00135	0.00200	0.01533	0.08173	0.17859	0.29327	0.21998	0.10049	0.02843	0.01080	0.00456	0.00481
2004	0.00018	0.00077	0.00094	0.00183	0.01211	0.00692	0.00161	0.00027	0.00112	0.00999	0.02554	0.11703	0.22729	0.28235	0.15403	0.07699	0.02404	0.00848	0.00353	0.00456

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1986	0.00218	0.00187	0.00208	0.00154	0.00051	0.00109	0.00005	0.00006	0.00008	0.00002	0.00013	0.00002	0.00005	0.00003	0.00002	0.00005	0.00000	0.00000	0.00000
1987	0.02689	0.02499	0.00539	0.00616	0.00755	0.00361	0.00418	0.00387	0.00319	0.00132	0.00000	0.00107	0.00025	0.00008	0.00000	0.00000	0.00000	0.00000	0.00000
2001	0.00160	0.00243	0.00129	0.00018	0.00039	0.00039	0.00039	0.00039	0.00078	0.00018	0.00039	0.00039	0.00078	0.00000	0.00228	0.00039	0.00000	0.00039	0.00000
2003	0.00448	0.00481	0.00541	0.00515	0.00653	0.00541	0.00306	0.00348	0.00290	0.00231	0.00131	0.00082	0.00045	0.00016	0.00031	0.00018	0.00038	0.00011	0.00014
2004	0.00198	0.00123	0.00130	0.00109	0.00181	0.00227	0.00411	0.00397	0.00439	0.00472	0.00457	0.00270	0.00145	0.00099	0.00125	0.00071	0.00085	0.00055	0.00045

South coast autumn survey, *M. paradoxus*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1988	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00158	0.00579	0.01164	0.02153	0.01023	0.01215	0.02922	0.12871	0.16024	0.16406	0.12072	0.10656	0.06703	0.04175
1992	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00109	0.00000	0.00109	0.00104	0.02097	0.07523	0.15797	0.26477	0.18693	0.12228	0.06115	0.03777	0.01878
1999	0.00000	0.00000	0.00000	0.00000	0.00002	0.00005	0.00000	0.00005	0.00011	0.00094	0.00303	0.01489	0.03857	0.09049	0.13949	0.12741	0.12570	0.09258	0.08256	0.06940
2003	0.00000	0.00000	0.00006	0.00013	0.00006	0.00019	0.00035	0.00001	0.00028	0.00218	0.01863	0.12583	0.35023	0.26862	0.07629	0.03782	0.02107	0.01431	0.01077	0.00905
2004	0.00000	0.00000	0.00017	0.00074	0.00145	0.03373	0.04122	0.01688	0.03251	0.06887	0.06755	0.07525	0.22912	0.18561	0.08579	0.05954	0.04338	0.02508	0.01348	0.00856
2005	0.00028	0.00254	0.00299	0.00208	0.01773	0.04683	0.07145	0.04575	0.01865	0.01637	0.04727	0.10667	0.09660	0.06904	0.06351	0.07212	0.08251	0.07588	0.03610	0.02584

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1988	0.04101	0.02563	0.01811	0.00944	0.00606	0.00653	0.00397	0.00244	0.00165	0.00150	0.00126	0.00041	0.00079	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1992	0.01330	0.01129	0.00266	0.00822	0.00474	0.00556	0.00052	0.00052	0.00017	0.00000	0.00107	0.00000	0.00289	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1999	0.05614	0.04793	0.02882	0.01862	0.01925	0.01511	0.00976	0.00498	0.00430	0.00186	0.00255	0.00095	0.00060	0.00086	0.00085	0.00043	0.00051	0.00086	0.00034
2003	0.00860	0.00771	0.00808	0.00492	0.00641	0.00536	0.00708	0.00579	0.00338	0.00260	0.00192	0.00089	0.00039	0.00035	0.00030	0.00006	0.00002	0.00000	0.00022
2004	0.00443	0.00139	0.00120	0.00062	0.00154	0.00006	0.00015	0.00028	0.00019	0.00033	0.00015	0.00000	0.00016	0.00033	0.00008	0.00000	0.00008	0.00000	0.00008
2005	0.01694	0.01737	0.01140	0.00588	0.00492	0.00841	0.00765	0.00778	0.00820	0.00458	0.00182	0.00209	0.00161	0.00068	0.00000	0.00014	0.00017	0.00000	0.00014

Table App.A.6b: *M. capensis*, sex-aggregated, survey catch-at-length data (Fairweather, pers. commn).

West coast summer survey, *M. capensis*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1985	0.00000	0.00000	0.00113	0.01039	0.02122	0.02247	0.04928	0.03158	0.02786	0.13459	0.32516	0.20242	0.07328	0.03355	0.01940	0.01154	0.00720	0.00477	0.00353	0.00416
1986	0.00000	0.00004	0.00088	0.00550	0.00956	0.00979	0.01251	0.02463	0.03989	0.09303	0.12151	0.14167	0.16217	0.13614	0.10180	0.05077	0.01628	0.00803	0.00916	0.00877
1987	0.00000	0.00000	0.00038	0.00454	0.01181	0.00606	0.00312	0.00848	0.02736	0.03029	0.04073	0.04990	0.10427	0.14954	0.11609	0.07647	0.04205	0.03991	0.04519	0.05158
1988	0.00000	0.00154	0.01877	0.07188	0.32985	0.18203	0.04145	0.03345	0.03482	0.02268	0.01778	0.02366	0.03572	0.03391	0.03164	0.02283	0.01740	0.01410	0.01004	0.00681
1990	0.00000	0.00000	0.00030	0.00014	0.00201	0.00729	0.01501	0.12422	0.29834	0.29664	0.15809	0.04427	0.01324	0.00872	0.00492	0.00569	0.00333	0.00269	0.00222	0.00212
1991	0.00000	0.00000	0.00225	0.01644	0.04608	0.03874	0.03414	0.03608	0.03631	0.07539	0.17667	0.17976	0.12657	0.06403	0.03392	0.01939	0.01516	0.01471	0.01255	0.01218
1992	0.00007	0.00107	0.00383	0.02237	0.09651	0.10192	0.08296	0.06228	0.05811	0.04448	0.03773	0.04946	0.07262	0.08712	0.06093	0.03961	0.02543	0.01926	0.01898	0.02173
2002	0.00032	0.00067	0.00341	0.02286	0.05167	0.09553	0.09158	0.19600	0.22583	0.09082	0.05085	0.04087	0.02134	0.01302	0.00824	0.00825	0.00621	0.00539	0.00453	0.00623
2003	0.00175	0.00096	0.01066	0.03480	0.12507	0.12410	0.09057	0.07529	0.06236	0.06887	0.08449	0.07345	0.04977	0.03330	0.02156	0.01279	0.00858	0.00576	0.00465	0.00365
2004	0.00042	0.00048	0.00804	0.00763	0.01122	0.03793	0.09809	0.13367	0.28641	0.23383	0.09887	0.03643	0.01611	0.00762	0.00527	0.00271	0.00187	0.00180	0.00156	0.00150
2005	0.00200	0.02976	0.15233	0.29899	0.17913	0.02432	0.01007	0.00691	0.01387	0.02609	0.06050	0.08359	0.04298	0.01965	0.01105	0.00620	0.00430	0.00268	0.00232	0.00203

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1985	0.00292	0.00275	0.00236	0.00215	0.00138	0.00069	0.00041	0.00096	0.00027	0.00056	0.00063	0.00048	0.00011	0.00030	0.00012	0.00016	0.00008	0.00003	0.00012
1986	0.00658	0.00764	0.00655	0.00567	0.00359	0.00249	0.00250	0.00216	0.00206	0.00193	0.00251	0.00132	0.00065	0.00089	0.00033	0.00023	0.00021	0.00027	0.00027
1987	0.05550	0.04566	0.03150	0.01934	0.00871	0.00557	0.00573	0.00360	0.00308	0.00310	0.00295	0.00136	0.00178	0.00154	0.00082	0.00032	0.00027	0.00039	0.00104
1988	0.00482	0.00582	0.00577	0.00372	0.00455	0.00420	0.00551	0.00496	0.00338	0.00227	0.00174	0.00113	0.00055	0.00039	0.00011	0.00022	0.00011	0.00002	0.00036
1990	0.00223	0.00214	0.00212	0.00146	0.00094	0.00063	0.00039	0.00019	0.00016	0.00012	0.00008	0.00010	0.00002	0.00005	0.00002	0.00004	0.00002	0.00002	0.00002
1991	0.01078	0.00873	0.00692	0.00454	0.00459	0.00454	0.00427	0.00380	0.00334	0.00295	0.00232	0.00086	0.00052	0.00040	0.00047	0.00021	0.00028	0.00004	0.00008
1992	0.02029	0.01567	0.01182	0.00636	0.00511	0.00428	0.00414	0.00415	0.00425	0.00348	0.00278	0.00234	0.00202	0.00163	0.00177	0.00070	0.00060	0.00042	0.00170
2002	0.00608	0.00576	0.00545	0.00579	0.00597	0.00634	0.00592	0.00519	0.00315	0.00185	0.00123	0.00081	0.00046	0.00059	0.00024	0.00036	0.00031	0.00018	0.00068
2003	0.00391	0.00510	0.00694	0.00822	0.00915	0.01041	0.00985	0.00958	0.01198	0.00937	0.00821	0.00446	0.00297	0.00283	0.00202	0.00083	0.00061	0.00036	0.00076
2004	0.00116	0.00105	0.00109	0.00076	0.00079	0.00042	0.00039	0.00026	0.00035	0.00036	0.00026	0.00045	0.00029	0.00031	0.00021	0.00013	0.00009	0.00005	0.00010
2005	0.00279	0.00337	0.00331	0.00305	0.00210	0.00140	0.00082	0.00072	0.00074	0.00085	0.00045	0.00046	0.00041	0.00012	0.00022	0.00014	0.00003	0.00006	0.00019

West coast winter survey, *M. capensis*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1985	0.00000	0.00005	0.00005	0.00016	0.00075	0.00489	0.03974	0.19280	0.27027	0.16467	0.07273	0.03963	0.03073	0.02559	0.02408	0.02075	0.01782	0.01813	0.01610	0.01154
1986	0.00000	0.00000	0.00040	0.00232	0.00141	0.00086	0.00202	0.02365	0.09136	0.12660	0.08709	0.05963	0.05949	0.07083	0.08353	0.09024	0.08642	0.06256	0.04002	0.02166
1987	0.00000	0.00000	0.00000	0.00215	0.00123	0.00442	0.03295	0.12805	0.19521	0.07186	0.03611	0.04720	0.03684	0.03077	0.03115	0.03637	0.04321	0.04696	0.04674	0.03934
1988	0.00015	0.00000	0.00152	0.01180	0.02485	0.01278	0.01050	0.05694	0.17348	0.23578	0.17917	0.07831	0.03967	0.02236	0.01121	0.00738	0.00755	0.00911	0.01458	0.01376
1989	0.00009	0.00010	0.00063	0.00137	0.06173	0.16558	0.12945	0.28079	0.22241	0.06360	0.02535	0.01299	0.00830	0.00400	0.00416	0.00372	0.00327	0.00307	0.00229	0.00190
1990	0.00044	0.00118	0.00080	0.00117	0.00560	0.03399	0.07116	0.10216	0.09167	0.11004	0.20911	0.12716	0.05356	0.02535	0.01824	0.01666	0.01641	0.01245	0.01205	0.00923

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1985	0.00819	0.00645	0.00534	0.00449	0.00396	0.00339	0.00413	0.00321	0.00202	0.00131	0.00097	0.00090	0.00079	0.00096	0.00092	0.00044	0.00039	0.00100	0.00066
1986	0.01267	0.00891	0.00721	0.00714	0.00753	0.00671	0.00605	0.00633	0.00598	0.00509	0.00342	0.00390	0.00238	0.00196	0.00137	0.00069	0.00044	0.00052	0.00160
1987	0.02478	0.02782	0.02352	0.02450	0.02083	0.01128	0.01072	0.00598	0.00372	0.00345	0.00294	0.00178	0.00198	0.00161	0.00127	0.00057	0.00044	0.00034	0.00190
1988	0.01449	0.01416	0.01173	0.00847	0.00798	0.00793	0.00748	0.00418	0.00535	0.00252	0.00183	0.00104	0.00054	0.00066	0.00013	0.00015	0.00013	0.00006	0.00027
1989	0.00151	0.00087	0.00048	0.00031	0.00028	0.00022	0.00021	0.00028	0.00019	0.00011	0.00015	0.00007	0.00008	0.00006	0.00008	0.00006	0.00002	0.00010	0.00009
1990	0.00779	0.00775	0.00756	0.00889	0.00919	0.00852	0.00782	0.00552	0.00478	0.00270	0.00178	0.00130	0.00132	0.00153	0.00114	0.00088	0.00118	0.00044	0.00151

South coast spring survey, *M. capensis*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1986	0.00000	0.00054	0.00100	0.00852	0.07285	0.15441	0.12701	0.03629	0.01505	0.00948	0.01038	0.01915	0.02768	0.03361	0.03154	0.03302	0.03438	0.03225	0.02634	0.02462
1987	0.00005	0.00049	0.00420	0.03445	0.09059	0.05826	0.02959	0.02643	0.02524	0.02146	0.01986	0.02222	0.03402	0.03962	0.03892	0.03645	0.04036	0.05319	0.05041	0.04224
2001	0.00115	0.00191	0.01613	0.05627	0.08054	0.06032	0.03848	0.02622	0.01930	0.01122	0.01265	0.01615	0.02076	0.02615	0.03043	0.03629	0.04919	0.05798	0.06803	0.07188
2003	0.00076	0.00514	0.02906	0.08192	0.07103	0.06018	0.05007	0.04068	0.02887	0.03482	0.03816	0.03493	0.02978	0.03314	0.03608	0.03565	0.03130	0.03108	0.03578	0.03698
2004	0.00170	0.01683	0.12033	0.18917	0.10450	0.03307	0.01312	0.01075	0.01233	0.01653	0.03018	0.04454	0.06517	0.05370	0.03911	0.02268	0.01850	0.01993	0.02091	0.02474

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1986	0.01978	0.02008	0.02334	0.02544	0.02673	0.02838	0.02388	0.02311	0.01948	0.01654	0.01299	0.01418	0.01198	0.01085	0.01001	0.00467	0.00335	0.00241	0.00468
1987	0.03355	0.03217	0.03317	0.03148	0.02955	0.02613	0.02418	0.02134	0.01938	0.01550	0.01195	0.01266	0.00991	0.00743	0.00575	0.00533	0.00274	0.00261	0.00713
2001	0.05997	0.04740	0.03626	0.03027	0.02424	0.02406	0.01794	0.01314	0.00943	0.00686	0.00763	0.00428	0.00558	0.00320	0.00232	0.00142	0.00145	0.00088	0.00262
2003	0.03109	0.02773	0.02707	0.02459	0.02039	0.01823	0.01693	0.01519	0.01117	0.01026	0.01252	0.00821	0.00657	0.00669	0.00521	0.00585	0.00271	0.00114	0.00304
2004	0.02440	0.02271	0.01932	0.01516	0.01309	0.01062	0.00765	0.00661	0.00473	0.00385	0.00369	0.00213	0.00211	0.00199	0.00133	0.00071	0.00064	0.00061	0.00088

South coast autumn survey, *M. capensis*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
1988	0.00058	0.00405	0.00455	0.01260	0.03767	0.05186	0.04949	0.04970	0.04929	0.05679	0.04762	0.04156	0.05088	0.06060	0.06451	0.05480	0.04016	0.03087	0.02859	0.03117
1992	0.00006	0.00014	0.00189	0.00545	0.01868	0.04256	0.04365	0.04906	0.06721	0.06875	0.07817	0.08134	0.06539	0.04389	0.03726	0.03193	0.03052	0.03528	0.03865	0.03733
2003	0.00005	0.00036	0.00148	0.01264	0.02955	0.05964	0.09490	0.09944	0.07252	0.05476	0.04828	0.03120	0.01875	0.01833	0.02513	0.03676	0.03734	0.03485	0.02907	0.03029
2004	0.00033	0.00168	0.00601	0.03397	0.07416	0.05592	0.04327	0.02147	0.02217	0.02668	0.02833	0.03018	0.02859	0.02758	0.04029	0.04040	0.04405	0.04358	0.04854	0.05154
2005	0.00338	0.00502	0.01279	0.02536	0.03033	0.05553	0.07130	0.06718	0.06472	0.05528	0.03805	0.03326	0.02094	0.01895	0.02148	0.03579	0.04827	0.05251	0.05488	0.05093

Length	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1988	0.03078	0.02923	0.02635	0.02628	0.02107	0.01951	0.01680	0.01433	0.01086	0.00837	0.00890	0.00539	0.00351	0.00251	0.00248	0.00145	0.00076	0.00112	0.00293
1992	0.03603	0.02785	0.02812	0.02742	0.02110	0.01703	0.01462	0.01109	0.00936	0.00792	0.00667	0.00368	0.00292	0.00255	0.00137	0.00127	0.00082	0.00029	0.00270
2003	0.03412	0.03587	0.03383	0.03160	0.02562	0.02092	0.01820	0.01332	0.01050	0.01078	0.00724	0.00561	0.00423	0.00306	0.00240	0.00172	0.00147	0.00088	0.00332
2004	0.04710	0.04472	0.04449	0.03392	0.03169	0.02552	0.02033	0.02100	0.01468	0.01121	0.00931	0.00649	0.00569	0.00426	0.00353	0.00179	0.00180	0.00120	0.00253
2005	0.04067	0.03477	0.03320	0.02584	0.02230	0.02056	0.01486	0.01183	0.00769	0.00649	0.00331	0.00310	0.00186	0.00186	0.00107	0.00155	0.00099	0.00015	0.00196

Table App.A.6c: *M. paradoxus*, sex-disaggregated, west coast summer survey catch-at-length data (Fairweather and Ross-Gillespie, pers. commn).

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37
1993	0.001	0.001	0.002	0.008	0.010	0.019	0.051	0.073	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.058	0.130	0.099	0.054	0.032	0.025	0.013	0.007	0.008
1993	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.080	0.092	0.048	0.045	0.024	0.014	0.011	0.006
1994	0.000	0.000	0.001	0.004	0.009	0.020	0.046	0.084	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.085	0.121	0.104	0.061	0.051	0.039	0.027	0.015	0.007
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.047	0.046	0.036	0.030	0.030	0.023	0.018	0.010
1995	0.000	0.000	0.001	0.002	0.015	0.055	0.144	0.135	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.118	0.075	0.047	0.051	0.043	0.030	0.016	0.008
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.129	0.018	0.016	0.011	0.012	0.010	0.009	0.005	0.002
1996	0.000	0.000	0.002	0.018	0.030	0.053	0.102	0.141	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.000	0.000	0.000	0.044	0.028	0.019	0.007	0.005
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.072	0.067	0.107	0.067	0.056	0.024	0.016	0.006
1997	0.000	0.000	0.000	0.001	0.009	0.037	0.051	0.079	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.043	0.056	0.163	0.058	0.040	0.012	0.008	0.006
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.080	0.105	0.002	0.058	0.026	0.016	0.008	0.004
1999	0.000	0.000	0.001	0.005	0.025	0.039	0.053	0.079	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.068	0.084	0.127	0.085	0.073	0.032	0.014	0.011	0.008
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.037	0.036	0.057	0.021	0.018	0.014	0.006	0.005
2006	0.000	0.001	0.003	0.012	0.026	0.037	0.045	0.069	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.045	0.068	0.064	0.076	0.066	0.039	0.012	0.004	0.003
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.057	0.054	0.072	0.072	0.061	0.034	0.015	0.009	0.007
2007	0.000	0.000	0.003	0.009	0.016	0.028	0.074	0.107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.073	0.067	0.053	0.057	0.033	0.024	0.014	0.009	0.005
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.049	0.046	0.065	0.064	0.057	0.045	0.028	0.016	0.014
2008	0.000	0.002	0.011	0.015	0.025	0.045	0.055	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.064	0.102	0.056	0.045	0.037	0.035	0.020	0.015	0.012
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.049	0.068	0.059	0.029	0.043	0.033	0.022	0.018	0.016
2009	0.000	0.002	0.010	0.024	0.047	0.130	0.230	0.158	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.044	0.034	0.017	0.009	0.008	0.008	0.006	0.005
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.049	0.039	0.033	0.024	0.012	0.009	0.009	0.009	0.006
2010	0.000	0.002	0.006	0.014	0.028	0.089	0.168	0.114	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.057	0.066	0.051	0.040	0.035	0.018	0.010	0.007	0.005
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.038	0.046	0.043	0.042	0.031	0.020	0.012	0.010	0.004
2011	0.000	0.001	0.010	0.036	0.065	0.086	0.076	0.156	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.099	0.050	0.021	0.012	0.013	0.021	0.019	0.019	0.015
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.078	0.045	0.021	0.018	0.020	0.013	0.011	0.010	0.008
2012	0.000	0.003	0.004	0.011	0.019	0.047	0.119	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.045	0.058	0.081	0.056	0.045	0.031	0.016	0.005	0.005
2012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.040	0.060	0.038	0.031	0.030	0.015	0.007	0.006
2013	0.000	0.000	0.003	0.014	0.032	0.034	0.062	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.106	0.105	0.054	0.042	0.037	0.026	0.013	0.006
2013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.058	0.069	0.049	0.030	0.024	0.015	0.006	0.004
2014	0.000	0.000	0.003	0.020	0.025	0.059	0.135	0.172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.051	0.047	0.067	0.050	0.023	0.012	0.008	0.004	0.003
2014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.062	0.033	0.055	0.066	0.034	0.021	0.011	0.010	0.007
2015	0.000	0.000	0.002	0.006	0.012	0.028	0.085	0.144	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.082	0.093	0.090	0.054	0.030	0.015	0.011	0.005	0.003
2015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.053	0.062	0.055	0.038	0.020	0.013	0.009	0.005
2016	0.000	0.000	0.002	0.004	0.017	0.058	0.126	0.184	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.095	0.074	0.050	0.024	0.019	0.016	0.009	0.006	0.005
2016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.087	0.061	0.040	0.029	0.023	0.019	0.011	0.008	0.005
2017	0.000	0.001	0.004	0.012	0.033	0.087	0.123	0.113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.059	0.053	0.061	0.051	0.028	0.013	0.006	0.004
2017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.040	0.042	0.055	0.044	0.020	0.014	0.008	0.004

Length	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71+
1993	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	0.008	0.005	0.003	0.004	0.002	0.002	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1993	0.005	0.003	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	0.003	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1994	0.007	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.004	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1995	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.004	0.003	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1996	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.003	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.007	0.005	0.003	0.003	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1999	0.005	0.006	0.005	0.004	0.003	0.003	0.002	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.002	0.004	0.004	0.003	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.005	0.004	0.004	0.004	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.004	0.004	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.008	0.005	0.004	0.002	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.008	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.010	0.007	0.005	0.003	0.002	0.002	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.005	0.004	0.003	0.003	0.002	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.003	0.003	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2010	0.005	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2011	0.013	0.008	0.006	0.004	0.003	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
2011	0.007	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.001	0.001	0.001	0.001	0.000
2012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.004	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2012	0.004	0.004	0.004	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000
2013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	0.004	0.004	0.002	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2013	0.003	0.002	0.003	0.002	0.002	0.001	0.001	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000
2014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2015	0.004	0.003	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000
2016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	0.004	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.004	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000

Table App.A.6d: *M. paradoxus*, sex-disaggregated, south coast survey catch-at-length data. (Fairweather and Ross-Gillespie, pers. commn).

South coast spring survey, *M. paradoxus*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
2006	0.00000	0.00000	0.00000	0.00000	0.00043	0.00000	0.00002	0.00722	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00191	0.01083	0.02194	0.11095	0.25930	0.25290	0.14056	0.04269	0.01166	0.00570	0.00224	0.00158	0.00092	0.00078	0.00035	0.00053	0.00018	0.00023	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00008	0.00000	0.00000	0.00000	0.00000	0.00000
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00250	0.00002	0.00268	0.00535	0.02528	0.03585	0.03151	0.00957	0.00396	0.00091	0.00152	0.00116	0.00037	0.00022	0.00007	0.00034	0.00035	0.00043	0.00118	0.00040	0.00075	0.00034	0.00062	0.00069	0.00020	0.00018	0.00008	0.00020	0.00012	0.00000	0.00014
2007	0.00000	0.00000	0.00000	0.00050	0.00059	0.00000	0.00088	0.00617	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00564	0.00573	0.00674	0.02803	0.13594	0.25140	0.19264	0.10330	0.06009	0.02690	0.01602	0.00641	0.00651	0.00177	0.00258	0.00039	0.00074	0.00034	0.00000	0.00034	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00440	0.00505	0.00032	0.00596	0.01240	0.01754	0.02973	0.01225	0.00789	0.00363	0.00387	0.00362	0.00135	0.00206	0.00237	0.00187	0.00276	0.00294	0.00432	0.00245	0.00451	0.00404	0.00113	0.00137	0.00073	0.00005	0.00034	0.00069	0.00069	0.00000	0.00000
2008	0.00000	0.00050	0.00106	0.00126	0.00552	0.00295	0.00201	0.00853	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00932	0.02113	0.00868	0.03393	0.14268	0.20498	0.15353	0.12138	0.09862	0.06319	0.03353	0.01265	0.01125	0.00650	0.00345	0.00121	0.00066	0.00040	0.00000	0.00015	0.00000	0.00000	0.00000	0.00000	0.00000	0.00056	0.00000	0.00000	0.00000	0.00000	0.00000
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00983	0.00272	0.00334	0.00111	0.00636	0.00787	0.00820	0.00371	0.00120	0.00025	0.00023	0.00107	0.00032	0.00012	0.00017	0.00014	0.00026	0.00033	0.00035	0.00037	0.00068	0.00009	0.00043	0.00017	0.00035	0.00017	0.00026	0.00009	0.00000	0.00009	0.00009

South coast autumn survey, *M. paradoxus*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1993	0.00000	0.00000	0.00000	0.00000	0.00005	0.00038	0.00011	0.00039	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1993	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00575	0.06354	0.21864	0.25075	0.14398	0.06196	0.02745	0.01520	0.00844	0.00444	0.00236	0.00070	0.00091	0.00033	0.00035	0.00000	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1993	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00064	0.00447	0.01085	0.02927	0.07109	0.04664	0.01331	0.00308	0.00286	0.00177	0.00155	0.00038	0.00044	0.00054	0.00086	0.00096	0.00095	0.00086	0.00082	0.00036	0.00019	0.00013	0.00027	0.00008	0.00030	0.00013	0.00017	0.00013	0.00009	0.00010	0.00010
1994	0.00006	0.00000	0.00032	0.00114	0.00116	0.00141	0.00064	0.00697	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1994	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.03401	0.10800	0.30529	0.19888	0.08252	0.06959	0.04029	0.03617	0.01256	0.01242	0.00288	0.00363	0.00370	0.00042	0.00064	0.00064	0.00056	0.00000	0.00002	0.00084	0.00000	0.00013	0.00006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1994	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00379	0.03256	0.00107	0.00050	0.00051	0.00027	0.00014	0.00041	0.00016	0.00006	0.00012	0.00004	0.00013	0.00041	0.00633	0.00088	0.00963	0.00234	0.00434	0.00101	0.00150	0.00119	0.00092	0.00078	0.00100	0.00064	0.00061	0.00043	0.00049	0.00093	0.00182
1995	0.00000	0.00000	0.00000	0.00065	0.00001	0.00000	0.00003	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1995	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00047	0.02274	0.10897	0.16501	0.13837	0.14263	0.10517	0.07340	0.03273	0.01984	0.00819	0.00067	0.00324	0.00306	0.00005	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000
1995	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002	0.00085	0.00491	0.03018	0.04863	0.04571	0.01073	0.00703	0.00128	0.00377	0.00144	0.00509	0.00497	0.00043	0.00027	0.00134	0.00166	0.00173	0.00218	0.00036	0.00104	0.00067	0.00006	0.00002	0.00001	0.00002	0.00000	0.00002	0.00025	0.00000	0.00000
1996	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1996	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00118	0.01878	0.09411	0.20254	0.21785	0.12608	0.07349	0.03783	0.01783	0.01057	0.00844	0.00530	0.00241	0.00083	0.00129	0.00000	0.00041	0.00044	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00021
1996	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00317	0.01049	0.01913	0.01955	0.02249	0.01608	0.00158	0.00122	0.00096	0.00204	0.00477	0.00443	0.00868	0.01058	0.01520	0.01354	0.01012	0.00686	0.00401	0.00232	0.00106	0.00066	0.00000	0.00000	0.00063	0.00021	0.00042	0.00000	0.00021
1997	0.00000	0.00000	0.00000	0.00000	0.00007	0.00000	0.00002	0.00011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1997	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00013	0.00080	0.00341	0.03008	0.05451	0.09835	0.13655	0.15410	0.13352	0.06028	0.02370	0.01131	0.00743	0.00350	0.00332	0.00215	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00026	0.00000	0.00022
1997	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00013	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00003	0.00002	0.00005	0.00015	0.00004	0.00111	0.00752	0.01946	0.03220	0.04412	0.04838	0.04486	0.02777	0.01967	0.01195	0.00599	0.00348	0.00297	0.00364	0.00082	0.00026	0.00042	0.00032
2006	0.00000	0.00000	0.00013	0.00000	0.00040	0.00000	0.00000	0.00013	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00038	0.01080	0.07997	0.16701	0.18487	0.16773	0.09418	0.05324	0.03402	0.01630	0.01295	0.00834	0.00642	0.00672	0.00343	0.00148	0.00021	0.00068	0.00054	0.00010	0.00038	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00059	0.00315	0.01094	0.01736	0.01145	0.01078	0.00445	0.00304	0.00082	0.00320	0.00295	0.00257	0.00166	0.00166	0.00399	0.00869	0.01269	0.01078	0.01077	0.00745	0.00525	0.00297	0.00374	0.00258	0.00172	0.00129	0.00086	0.00000	0.00215
2007	0.00000	0.00000	0.00023	0.00209	0.03448	0.03300	0.00579	0.00361	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00598	0.00402	0.01336	0.05512	0.11969	0.14937	0.09521	0.07168	0.05944	0.05540	0.04695	0.03175	0.01893	0.00340	0.00173	0.00014	0.00040	0.00005	0.00002	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00347	0.00239	0.00036	0.01218	0.02641	0.02671	0.01747	0.00974	0.01131	0.02937	0.02449	0.00753	0.00177	0.00428	0.00114	0.00093	0.00131	0.00109	0.00095	0.00088	0.00070	0.00051	0.00080	0.00079	0.00019	0.00040	0.00025	0.00030	0.00005	0.00005	0.00024
2008	0.00000	0.00000	0.00000	0.00110	0.00220	0.00160	0.00085	0.00106	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00008	0.00157	0.01575	0.03961	0.04715	0.06589	0.09629	0.11893	0.10791	0.08684	0.07074	0.04801	0.03429	0.02003	0.01280	0.00315	0.00104	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00009	0.00355	0.01865	0.01444	0.01373	0.02005	0.01692	0.02449	0.01755	0.01759	0.02211	0.00898	0.01011	0.00918	0.00894	0.00448	0.00298	0.00079	0.00242	0.00000	0.00076	0.00112	0.00111	0.00087	0.00025	0.00111	0.00055	0.00000	0.00000	0.00000
2009	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2009	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00030	0.00016	0.00214	0.00928	0.01369	0.03448	0.06954	0.10042	0.16637	0.15187	0.10986	0.06511	0.03979	0.02358	0.01225	0.00426	0.00354	0.00180	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2009	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00018	0.00000	0.00005	0.00091	0.00538	0.00769	0.01707	0.03302	0.04308	0.02963	0.01687	0.01019	0.00607	0.00148	0.00360	0.00145	0.00184	0.00273	0.00277	0.00129	0.00153	0.00120	0.00138	0.00125	0.00013	0.00037	0.00006	0.00011	0.00000	0.00002	0.00002
2010	0.00000	0.00000	0.00022	0.00009	0.00001	0.00020	0.00040	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00153	0.00058	0.00521	0.02469	0.07440	0.09613	0.08548	0.12389	0.11062	0.07450	0.04526	0.03928	0.01194	0.01425	0.01198	0.00123	0.00017	0.00034	0.00000	0.00013	0.00066	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00004	0.00005	0.00052	0.00593	0.02219	0.02535	0.03564	0.04073	0.04556	0.03604	0.01564	0.00709	0.01568	0.00425	0.00269	0.00464	0.00515	0.00182	0.00194	0.00160	0.00101	0.00098	0.00020	0.00103	0.00039	0.00010	0.00010	0.00000	0.00000	0.00044	0.00000
2011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00089	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00089	0.00021	0.00215	0.01928	0.05252	0.08221	0.09069	0.07355	0.06412	0.04844	0.03803	0.01873	0.01342	0.00861	0.00346	0.00530	0.00107	0.00016	0.00000	0.00000	0.00000	0.00000	0.00004	0.00000	0.00000	0.00007	0.00000	0.00000	0.00037	0.00000	0.00000
2011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00089	0.00089	0.00389	0.01800	0.05087	0.07176	0.06593	0.03502	0.03214	0.02410	0.01051	0.00784	0.01043	0.01004	0.01217	0.01466	0.02229	0.01984	0.01437	0.01383	0.00843	0.00863	0.00521	0.00296	0.00183	0.00228	0.00177	0.00150	0.00103	0.00043	0.00223
2014	0.00000	0.00000	0.00273	0.00318	0.00247	0.00035	0.00035	0.00003	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2014	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00074	0.00052	0.01465	0.07615	0.10947	0.15092	0.13131	0.07361	0.04031	0.01996	0.01308	0.00725	0.00812	0.00780	0.00483	0.00452	0.00187	0.00061	0.00021	0.00003	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000	0.00028	0.00000	0.00004
2014	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00013	0.00052	0.00148	0.01023	0.02058	0.03492	0.06170	0.04110	0.01828	0.01233	0.01420	0.00973	0.01067	0.01045	0.01160	0.01228	0.01464	0.00956	0.00592	0.00453	0.00290	0.00233	0.00226	0.00147	0.00188	0.00222	0.00084	0.00073	0.00126	0.00069	0.00313
2015	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00053	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2015	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00059	0.01044	0.03025	0.07703	0.16882	0.15064	0.11912	0.04188	0.02746	0.00916	0.00563	0.00387	0.00235	0.00108	0.00032	0.00032	0.00023	0.00005	0.00001	0.00003	0.00000	0.00003	0.00002	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2015	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00079	0.00585	0.02516	0.05185	0.06700	0.07111	0.04634	0.03519	0.01516	0.00488	0.00438	0.00167	0.00150	0.00197	0.00231	0.00310	0.00311	0.00249	0.00182	0.00104	0.00091	0.00052	0.00040	0.00044	0.00026	0.00024	0.00007	0.00024	0.00010	0.00021
2016	0.00000	0.00000	0.00000	0.00001	0.00031	0.00040	0.00028	0.00016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00177	0.00137	0.00935	0.04703	0.13964	0.18996	0.16257	0.10058	0.04515	0.02125	0.00426	0.00265	0.00368	0.00183	0.00124	0.00046	0.00015	0.00004	0.00005	0.00000	0.00001	0.00000	0.00000	0.00011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00008	0.00029	0.00624	0.01474	0.05555	0.05776	0.04363	0.01946	0.01039	0.00690	0.00457	0.00396	0.00274	0.00302	0.00338	0.00367	0.00436	0.00539	0.00585	0.00446	0.00319	0.00198	0.00118	0.00070	0.00042	0.00041	0.00034	0.00024	0.00019	0.00013	0.00046

Table App.A.6e: *M. capensis*, sex-disaggregated, west coast summer survey catch-at-length data (Fairweather and Ross-Gillespie, pers. commn).

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71
1993	0.000	0.001	0.023	0.090	0.077	0.032	0.011	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1993	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.007	0.016	0.049	0.055	0.052	0.041	0.039	0.029	0.010	0.008	0.007	0.005	0.004	0.007	0.005	0.006	0.002	0.005	0.005	0.002	0.002	0.001	0.001	0.000	0.009
1993	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.005	0.015	0.030	0.053	0.045	0.050	0.043	0.029	0.019	0.009	0.005	0.006	0.010	0.007	0.009	0.007	0.008	0.005	0.005	0.005	0.003	0.003	0.002	0.003	0.000
1994	0.000	0.000	0.030	0.307	0.028	0.018	0.025	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.029	0.033	0.039	0.042	0.037	0.021	0.011	0.005	0.004	0.003	0.005	0.004	0.006	0.005	0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.001	0.001	0.001	0.011
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.014	0.027	0.027	0.029	0.030	0.027	0.017	0.012	0.007	0.004	0.004	0.005	0.007	0.008	0.007	0.006	0.005	0.004	0.004	0.006	0.006	0.006	0.005	0.004	0.000
1995	0.000	0.000	0.000	0.001	0.008	0.019	0.044	0.121	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.146	0.153	0.088	0.016	0.005	0.003	0.003	0.004	0.002	0.002	0.003	0.002	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.002
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.105	0.092	0.075	0.037	0.012	0.008	0.006	0.004	0.004	0.003	0.001	0.002	0.002	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.004	0.046	0.126	0.163	0.069	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.026	0.044	0.038	0.026	0.014	0.011	0.007	0.005	0.005	0.005	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.003	0.002	0.002	0.000	0.000	0.008
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.051	0.014	0.007	0.036	0.045	0.037	0.026	0.017	0.016	0.018	0.013	0.006	0.005	0.005	0.004	0.002	0.003	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.002	0.000
1997	0.000	0.000	0.003	0.015	0.011	0.008	0.010	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.041	0.000	0.054	0.103	0.118	0.081	0.024	0.012	0.005	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.074	0.115	0.112	0.077	0.036	0.028	0.010	0.007	0.002	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.000
1999	0.000	0.035	0.372	0.202	0.142	0.107	0.033	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.006	0.008	0.006	0.006	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.001
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.003	0.003	0.004	0.004	0.004	0.001	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.001	0.001	0.000	0.000	0.000
2006	0.001	0.011	0.169	0.116	0.051	0.041	0.121	0.189	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.045	0.025	0.011	0.005	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.064	0.027	0.045	0.025	0.010	0.006	0.005	0.004	0.003	0.002	0.002	0.001	0.000	0.001	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000
2007	0.000	0.001	0.005	0.011	0.016	0.011	0.019	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.059	0.095	0.084	0.049	0.030	0.017	0.011	0.005	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.070	0.136	0.108	0.071	0.047	0.024	0.010	0.005	0.004	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
2008	0.000	0.014	0.099	0.064	0.080	0.077	0.110	0.135	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.013	0.012	0.015	0.016	0.015	0.010	0.006	0.005	0.005	0.007	0.007	0.010	0.007	0.007	0.005	0.004	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.031	0.014	0.012	0.014	0.017	0.017	0.015	0.012	0.009	0.010	0.010	0.017	0.018	0.019	0.013	0.010	0.004	0.003	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.000
2009	0.000	0.002	0.029	0.034	0.033	0.029	0.045	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.087	0.078	0.026	0.007	0.002	0.001	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.156	0.185	0.089	0.025	0.010	0.007	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000
2010	0.000	0.001	0.008	0.019	0.031	0.045	0.104	0.405	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.116	0.023	0.012	0.005	0.004	0.002	0.002	0.002	0.002	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.105	0.030	0.020	0.014	0.006	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
2011	0.000	0.010	0.101	0.456	0.235	0.028	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.007	0.008	0.009	0.006	0.006	0.002	0.002	0.002	0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.017	0.019	0.015	0.014	0.012	0.006	0.002	0.001	0.001	0.000	0.000	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
2012	0.000	0.001	0.010	0.025	0.025	0.046	0.121	0.222	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.068	0.043	0.038	0.017	0.005	0.003	0.003	0.003	0.002	0.001	0.001	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.004
2012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086	0.062	0.077	0.043	0.018	0.007	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.004	0.004	0.003	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.000
2013	0.000	0.000	0.006	0.442	0.406	0.042	0.029	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.006	0.003	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.002
2013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.006	0.004	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.000
2014	0.000	0.000	0.001	0.009	0.021	0.010	0.008	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.186	0.110	0.029	0.005	0.001	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008
2014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.185	0.154	0.056	0.019	0.009	0.005	0.005	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	0.001	0.009	0.010	0.124	0.239	0.173	0.121	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.007	0.010	0.011	0.018	0.014	0.014	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.005
2015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.010	0.012	0.019	0.024	0.030	0.021	0.016	0.008	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.000
2016	0.000	0.004	0.016	0.063	0.107	0.080	0.033	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.040	0.035	0.036	0.030	0.028	0.022	0.013	0.010	0.004	0.002	0.001	0.001	0.002	0.003	0.003	0.003	0.002	0.000	0.001	0.001	0.001	0.001	0.000	0.000	0.006
2016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.039	0.053	0.045	0.042	0.034	0.037	0.031	0.016	0.009	0.007	0.003	0.003	0.004	0.008	0.007	0.008	0.004	0.003	0.002	0.002	0.003	0.004	0.004	0.003	0.000
2017	0.000	0.001	0.010	0.009	0.005	0.004	0.008	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.037	0.073	0.097	0.095	0.049	0.024	0.009	0.007	0.003	0.002	0.005	0.005	0.005	0.004	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.003
2017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.038	0.062	0.087	0.100	0.052	0.041	0.023	0.011	0.010	0.007	0.006	0.006	0.008	0.007	0.006	0.005	0.004	0.002	0.001	0.002	0.003	0.003	0.002	0.002	0.001

Table App.A.6f: *M. capensis*, sex-disaggregated, south coast survey catch-at-length data (Fairweather and Ross-Gillespie, pers. commn).

South coast spring survey, *M. capensis*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
2006	0.00324	0.00741	0.02736	0.04789	0.06663	0.04115	0.01913	0.01614	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01956	0.02945	0.02953	0.02836	0.02706	0.02032	0.02167	0.02701	0.03666	0.03190	0.02772	0.01997	0.01356	0.01124	0.00945	0.00754	0.00667	0.00782	0.00608	0.00361	0.00397	0.00281	0.00211	0.00153	0.00070	0.00026	0.00012	0.00007	0.00020	0.00000	0.00009
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01286	0.02281	0.03310	0.02916	0.02490	0.02507	0.02530	0.03036	0.02214	0.02485	0.02212	0.01779	0.01659	0.01218	0.00912	0.00675	0.00544	0.00379	0.00435	0.00332	0.00238	0.00264	0.00349	0.00308	0.00264	0.00221	0.00236	0.00114	0.00102	0.00048	0.00056
2007	0.00054	0.00647	0.03208	0.07771	0.18343	0.14037	0.04886	0.02264	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01059	0.00859	0.01501	0.01988	0.02593	0.02798	0.02206	0.01805	0.01692	0.01565	0.01228	0.01089	0.00820	0.00636	0.00558	0.00280	0.00315	0.00344	0.00197	0.00135	0.00215	0.00119	0.00035	0.00070	0.00006	0.00036	0.00021	0.00020	0.00013	0.00000	0.00012
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00910	0.01061	0.01456	0.02470	0.03170	0.02826	0.02275	0.01634	0.01300	0.01129	0.00905	0.00841	0.00788	0.00557	0.00498	0.00481	0.00341	0.00191	0.00267	0.00154	0.00166	0.00186	0.00141	0.00203	0.00164	0.00081	0.00109	0.00099	0.00088	0.00039	0.00045
2008	0.00136	0.00868	0.03297	0.09534	0.14598	0.11347	0.05113	0.02118	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01147	0.00712	0.00814	0.00983	0.01207	0.01629	0.02226	0.02489	0.02235	0.01907	0.01751	0.01448	0.01400	0.01078	0.01012	0.00790	0.00761	0.00745	0.00433	0.00402	0.00386	0.00281	0.00222	0.00065	0.00016	0.00007	0.00057	0.00004	0.00000	0.00000	0.00022
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00321	0.00695	0.00917	0.01297	0.01449	0.01744	0.02086	0.02702	0.02105	0.01790	0.01228	0.01386	0.01381	0.01186	0.00994	0.00935	0.00608	0.00665	0.00588	0.00370	0.00345	0.00675	0.00284	0.00319	0.00207	0.00137	0.00079	0.00071	0.00087	0.00022	0.00087

South coast autumn survey, *M. capensis*

Length	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81+
1993	0.00000	0.00012	0.00012	0.00181	0.01205	0.02991	0.03658	0.04437	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1993	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00892	0.00847	0.01382	0.01976	0.01642	0.01431	0.01773	0.01340	0.02106	0.02941	0.04230	0.05027	0.04827	0.03996	0.03120	0.01998	0.01682	0.01220	0.01079	0.01180	0.00890	0.00682	0.00552	0.00299	0.00244	0.00186	0.00097	0.00046	0.00038	0.00009	0.00028
1993	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02256	0.01200	0.00903	0.01116	0.01320	0.01404	0.01192	0.01471	0.01648	0.02314	0.02546	0.03505	0.03988	0.03746	0.02443	0.01972	0.01053	0.00801	0.00753	0.00434	0.00531	0.00609	0.00413	0.00396	0.00405	0.00255	0.00256	0.00186	0.00178	0.00083	0.00363
1994	0.00054	0.00176	0.00791	0.01808	0.02407	0.03338	0.05359	0.05381	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1994	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02597	0.02080	0.02120	0.01669	0.01912	0.02457	0.02473	0.02495	0.02431	0.01825	0.01669	0.01209	0.01475	0.01725	0.01718	0.01574	0.01837	0.01960	0.01967	0.01541	0.01170	0.01275	0.00720	0.00952	0.00461	0.00270	0.00189	0.00111	0.00063	0.00019	0.00012
1994	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02244	0.01644	0.01215	0.01690	0.01628	0.01933	0.02291	0.01908	0.01895	0.01446	0.00988	0.00767	0.00996	0.01196	0.01558	0.01441	0.01224	0.01208	0.00822	0.01062	0.01465	0.00882	0.01305	0.00671	0.00846	0.00483	0.00348	0.00336	0.00252	0.00247	0.00718
1995	0.00007	0.00084	0.00755	0.00986	0.01857	0.03928	0.05111	0.05443	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1995	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01493	0.02256	0.02476	0.02250	0.01658	0.01965	0.02587	0.02955	0.02386	0.01670	0.02025	0.01972	0.01429	0.01738	0.01614	0.01581	0.01218	0.01146	0.00973	0.00816	0.00430	0.00470	0.00629	0.00245	0.00241	0.00196	0.00086	0.00034	0.00005	0.00004	0.00030
1995	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.03947	0.03390	0.02080	0.01785	0.02011	0.02379	0.02519	0.03394	0.03192	0.02252	0.01524	0.01567	0.02288	0.01604	0.01469	0.01074	0.01253	0.00797	0.00814	0.00657	0.00682	0.00640	0.00261	0.00404	0.00242	0.00148	0.00277	0.00215	0.00090	0.00084	0.00214
1996	0.00008	0.00097	0.00175	0.00783	0.01870	0.04460	0.06679	0.05702	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1996	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02142	0.01565	0.01476	0.01490	0.01143	0.01498	0.02285	0.02388	0.02630	0.03381	0.04014	0.03564	0.02273	0.01818	0.01268	0.01236	0.01195	0.00917	0.00721	0.00724	0.00568	0.00404	0.00397	0.00302	0.00183	0.00127	0.00031	0.00028	0.00005	0.00010	0.00001
1996	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01595	0.01377	0.01465	0.01101	0.01590	0.02561	0.02710	0.02536	0.02769	0.03117	0.03099	0.02682	0.02510	0.01942	0.01736	0.01536	0.00996	0.00864	0.00817	0.00442	0.00523	0.00507	0.00328	0.00274	0.00257	0.00173	0.00239	0.00173	0.00126	0.00099	0.00303
1997	0.00032	0.00067	0.00192	0.01568	0.04622	0.05006	0.04404	0.03788	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1997	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02693	0.01429	0.00741	0.01920	0.01955	0.02309	0.02070	0.02367	0.02079	0.02393	0.02424	0.02534	0.02363	0.02603	0.02681	0.02517	0.01770	0.01949	0.01474	0.00974	0.01293	0.00831	0.00766	0.00953	0.00538	0.00184	0.00315	0.00212	0.00123	0.00019	0.00044
1997	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00496	0.01058	0.00831	0.01806	0.02135	0.02011	0.01693	0.01563	0.01511	0.01658	0.01782	0.01727	0.01533	0.01542	0.01625	0.01258	0.01010	0.01116	0.01033	0.00687	0.00797	0.00652	0.00540	0.00742	0.00722	0.00481	0.00444	0.00297	0.00248	0.00803
1999	0.00043	0.00045	0.00127	0.01475	0.04512	0.04174	0.03882	0.04122	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1999	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.03298	0.01847	0.05007	0.05557	0.05369	0.02374	0.01725	0.01542	0.01159	0.01864	0.02398	0.02796	0.02477	0.01934	0.01611	0.01528	0.01521	0.01063	0.00948	0.00728	0.00635	0.00568	0.00291	0.00390	0.00266	0.00080	0.00120	0.00081	0.00058	0.00068	0.00005
1999	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00297	0.01588	0.00381	0.03762	0.03834	0.04187	0.01917	0.00802	0.01159	0.00919	0.01403	0.01530	0.01400	0.01184	0.01104	0.00895	0.00817	0.00703	0.00528	0.00508	0.00517	0.00390	0.00408	0.00378	0.00259	0.00344	0.00250	0.00237	0.00196	0.00093	0.00322
2006	0.00000	0.00015	0.00025	0.00244	0.01339	0.02582	0.02616	0.02403	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01367	0.01404	0.02178	0.02431	0.03174	0.03070	0.04045	0.03832	0.03370	0.03402	0.02645	0.02101	0.02100	0.01551	0.01744	0.01300	0.01523	0.01004	0.00901	0.00906	0.00662	0.00432	0.00287	0.00200	0.00218	0.00041	0.00019	0.00028	0.00000	0.00000	0.00013
2006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01214	0.01756	0.01800	0.02592	0.02482	0.02970	0.03214	0.03531	0.03080	0.02789	0.02885	0.02420	0.01795	0.01395	0.01254	0.01052	0.00721	0.01155	0.01057	0.01035	0.01223	0.00873	0.00588	0.00455	0.00426	0.00350	0.00224	0.00144	0.00093	0.00063	0.00194
2007	0.00069	0.00209	0.01530	0.06976	0.14850	0.13719	0.09154	0.04530	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01937	0.01651	0.01210	0.01843	0.02133	0.02218	0.02016	0.02007	0.01848	0.01539	0.01135	0.01091	0.00921	0.00644	0.00480	0.00351	0.00240	0.00355	0.00189	0.00153	0.00135	0.00093	0.00064	0.00056	0.00046	0.00031	0.00000	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01525	0.01590	0.01729	0.01487	0.02032	0.02471	0.02405	0.01509	0.01199	0.01561	0.01400	0.01019	0.00901	0.00771	0.00553	0.00580	0.00335	0.00210	0.00229	0.00213	0.00124	0.00147	0.00119	0.00095	0.00106	0.00054	0.00059	0.00040	0.00041	0.00025	0.00047
2008	0.00070	0.00121	0.00216	0.00655	0.01311	0.02719	0.03254	0.05452	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.05175	0.04822	0.04333	0.03432	0.02542	0.01930	0.01629	0.01550	0.01932	0.02619	0.02356	0.02324	0.01671	0.01434	0.01436	0.01026	0.00902	0.00780	0.00517	0.00253	0.00346	0.00143	0.00111	0.00050	0.00034	0.00002	0.00000	0.00000	0.00000	0.00000	0.00009
2008	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.03394	0.03799	0.04084	0.03837	0.02683	0.01799	0.01323	0.01635	0.01553	0.02184	0.02499	0.02174	0.01874	0.01533	0.01282	0.01362	0.01214	0.01084	0.00960	0.00578	0.00387	0.00548	0.00318	0.00171	0.00205	0.00109	0.00059	0.00091	0.00060	0.00015	0.00033
2009	0.00004	0.00212	0.01955	0.06592	0.06037	0.03686	0.02331	0.02707	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2009	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02652	0.02429	0.01934	0.01657	0.02356	0.02954	0.04602	0.05143	0.04154	0.02507	0.01845	0.01506	0.01596	0.01341	0.01108	0.00772	0.00837	0.00677	0.00471	0.00522	0.00329	0.00234	0.00305	0.00042	0.00070	0.00003	0.00018	0.00021	0.00008	0.00005	0.00004
2009	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01251	0.01275	0.01557	0.01775	0.02191	0.02905	0.03899	0.04124	0.02648	0.01905	0.01442	0.01234	0.01185	0.01137	0.01054	0.00879	0.00790	0.00688	0.00617	0.00387	0.00325	0.00250	0.00158	0.00176	0.00153	0.00099	0.00093	0.00024	0.00025	0.00033	0.00093
2010	0.00197	0.00500	0.06666	0.14429	0.09042	0.10100	0.06277	0.03022	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01461	0.01051	0.01499	0.01317	0.01058	0.01686	0.01751	0.01442	0.00979	0.00932	0.00885	0.01083	0.01187	0.01422	0.00978	0.00936	0.00601	0.00614	0.00358	0.00263	0.00145	0.00147	0.00134	0.00034	0.00057	0.00002	0.00018	0.00006	0.00000	0.00000	0.00000
2010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00828	0.00964	0.00874	0.01180	0.01929	0.02130	0.02250	0.01598	0.01407	0.01209	0.01185	0.01177	0.01526	0.01079	0.01363	0.01118	0.00810	0.00878	0.00666	0.00637	0.00427	0.00325	0.00437	0.00390	0.00245	0.00259	0.00218	0.00222	0.00077	0.00135	0.00176
2011	0.00470	0.01431	0.05927	0.04170	0.04760	0.06867	0.04544	0.03123	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01609	0.01395	0.00959	0.00860	0.01333	0.01376	0.01736	0.02536	0.02729	0.03112	0.02908	0.02244	0.02093	0.01590	0.00955	0.00974	0.00862	0.00658	0.00618	0.00704	0.00481	0.00467	0.00385	0.00310	0.00154	0.00028	0.00053	0.00001	0.00004	0.00013	0.00000
2011	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01401	0.00858	0.00848	0.01008	0.01232	0.01592	0.01669	0.01955	0.02348	0.03124	0.03131	0.02726	0.01850	0.01537	0.01207	0.00811	0.00715	0.00819	0.00658	0.00767	0.00791	0.00797	0.00576	0.00967	0.00450	0.00629	0.00300	0.00302	0.00191	0.00071	0.00230
2014	0.00120	0.00517	0.01027	0.00433	0.02370	0.06881	0.04336	0.02598	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2014	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01313	0.01207	0.01731	0.01923	0.01989	0.02240	0.02731	0.03760	0.04839	0.03347	0.02437	0.01849	0.01818	0.01354	0.01358	0.01321	0.00880	0.00669	0.00725	0.00447	0.00376	0.00285	0.00325	0.00193	0.00081	0.00031	0.00042	0.00000	0.00000	0.00010	0.00020
2014	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01341	0.01779	0.02187	0.02515	0.02568	0.02639	0.02531	0.03392	0.03559	0.03698	0.02372	0.02237	0.02035	0.01792	0.01196	0.00871	0.01106	0.00898	0.00687	0.00586	0.00578	0.00316	0.00218	0.00291	0.00234	0.00202	0.00220	0.00035	0.00145	0.00054	0.00134
2015	0.00106	0.00335	0.06499	0.15313	0.07054	0.02787	0.01368	0.00892	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2015	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00314	0.00583	0.01295	0.02026	0.02346	0.02916	0.03084	0.03009	0.02735	0.02906	0.02754	0.02172	0.01677	0.01209	0.01001	0.00908	0.00685	0.00578	0.00551	0.00323	0.00281	0.00181	0.00088	0.00096	0.00040	0.00024	0.00011	0.00001	0.00005	0.00000	0.00000
2015	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00746	0.00851	0.00964	0.01377	0.02279	0.02311	0.02252	0.02616	0.02317	0.02355	0.02070	0.02006	0.01600	0.01413	0.01322	0.00860	0.00832	0.00767	0.00822	0.00359	0.00301	0.00352	0.00177	0.00132	0.00160	0.00113	0.00154	0.00117	0.00115	0.00028	0.00081
2016	0.00310	0.05956	0.25968	0.14386	0.02672	0.01112	0.00787	0.01124	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00782	0.00940	0.00931	0.01263	0.01304	0.02292	0.02639	0.02738	0.01821	0.01493	0.00779	0.00859	0.00743	0.00842	0.00532	0.00580	0.00449	0.00310	0.00234	0.00297	0.00189	0.00135	0.00064	0.00025	0.00032	0.00011	0.00008	0.00012	0.00010	0.00000	0.00003
2016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00330	0.00796	0.01157	0.00998	0.01174	0.01675	0.02532	0.03003	0.03078	0.02167	0.01795	0.01238	0.00993	0.00700	0.00896	0.00564	0.00369	0.00372	0.00329	0.00185	0.00110	0.00160	0.00190	0.00154	0.00133	0.00063	0.00062	0.00062	0.00011	0.00014	0.00060

Appendix B: Reference Case results[7]

Table B1: Estimates of management quantities for the Reference Case.

	-lnL total	-3144.8
M. paradoxus	K^{sp}	280
	B^{sp}_{MSY}	54
	B^{sp}_{2017}	83
	B^{sp}_{2017}/K^{sp}	0.30
	$B^{sp}_{2017}/B^{sp}_{MSY}$	1.54
	MSY	145
M. capensis	K^{sp}	273
	B^{sp}_{MSY}	81
	B^{sp}_{2017}	186
	B^{sp}_{2017}/K^{sp}	0.68
	$B^{sp}_{2017}/B^{sp}_{MSY}$	2.29
	MSY	84

[7] Note that the time of the compilation of this document, the authors are aware of one update to the Reference Case model that still needs to be implemented. The required update pertains to assumptions made about the length of the hake in the plus age group (15 years). Currently the length-structure for the oldest hake in the plug-group is assumed to be a normal distribution about the mean length for that age group. Since the plus group includes fish older than 15 years, some more thought needs to be given about the length structure for the plus group. Preliminary investigations suggest that any changes made in this regard will have minimal impact on the assessment results.

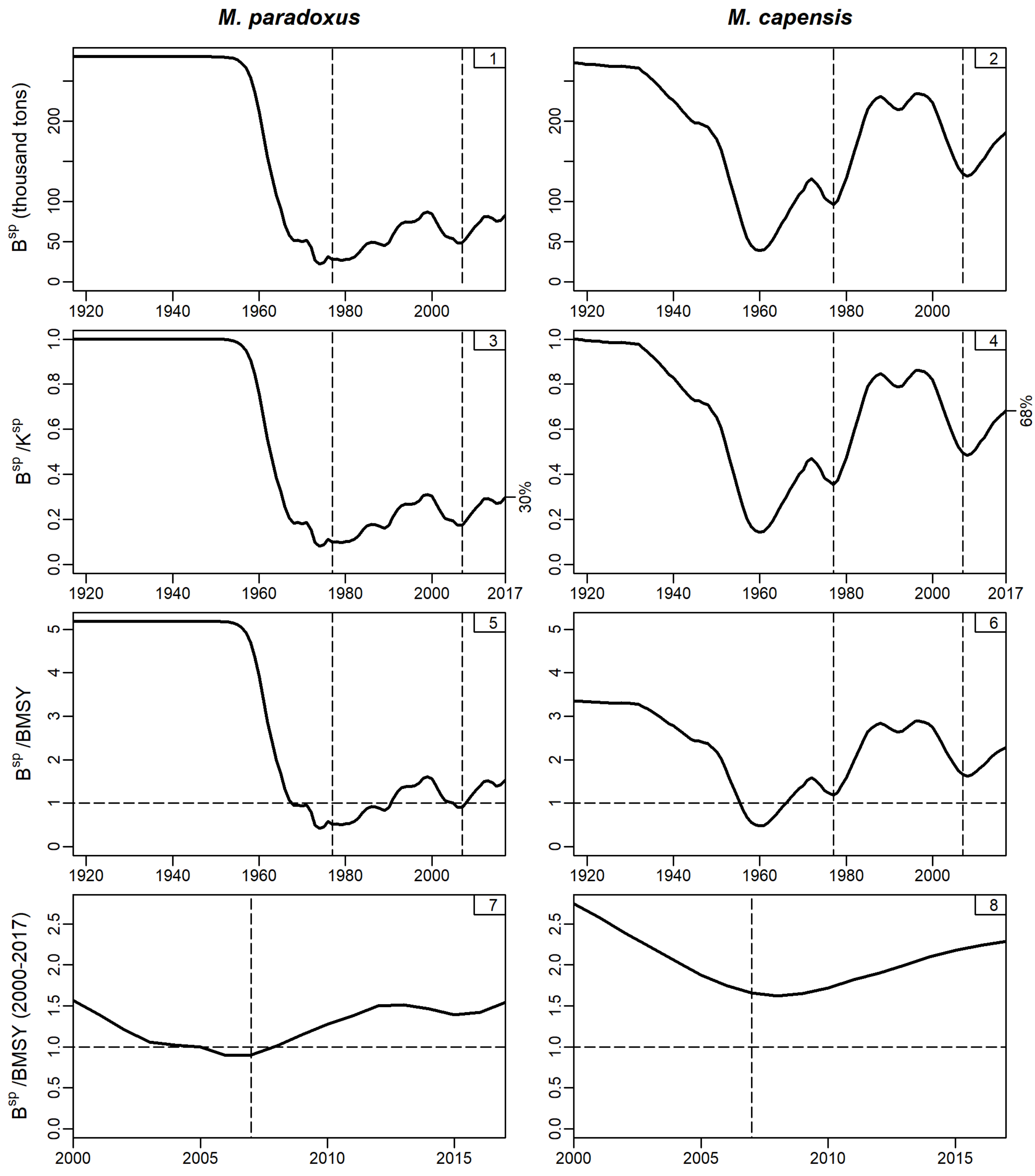

Figure B1: Spawning biomass trajectories (in absolute terms, and relative to pre-exploitation level and B_{MSY}) for the RC. The last row repeats the B^{sp}/B_{MSY} trajectory but with a restricted year range. The percentages reported to the right of the B^{sp}/K^{sp} plots (second row) are the 2017 estimates of depletion. The small numbers in the top-right corner are purely for reference purposes. The vertical dashed lines mark the years 1977 and 2007, years in which historically fishing catch rates were low.

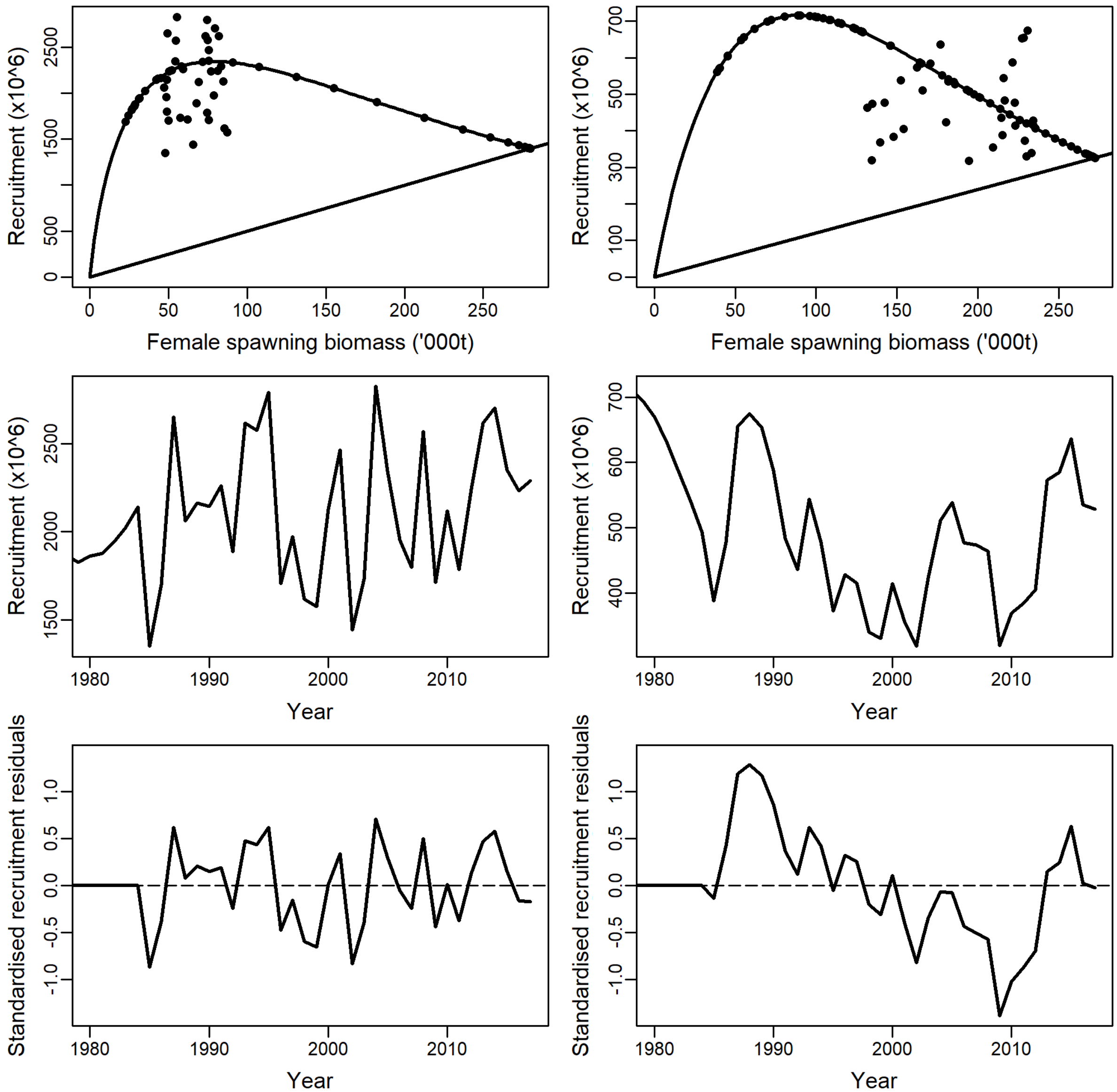

Figure B2: Stock-recruitment curves and recruitment trajectories for the Reference Case.

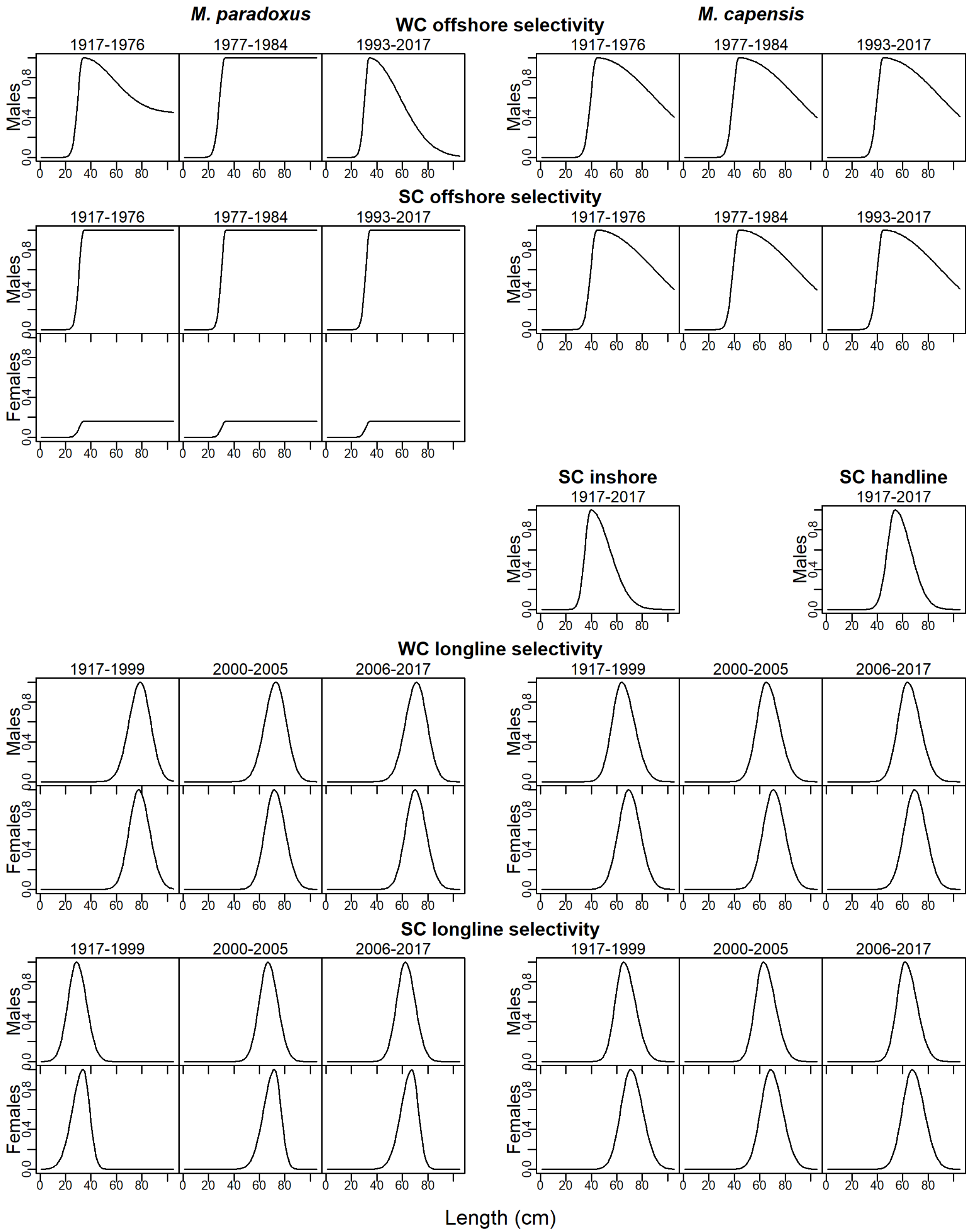

Figure B3: Survey selectivities-at-length for the Reference Case.

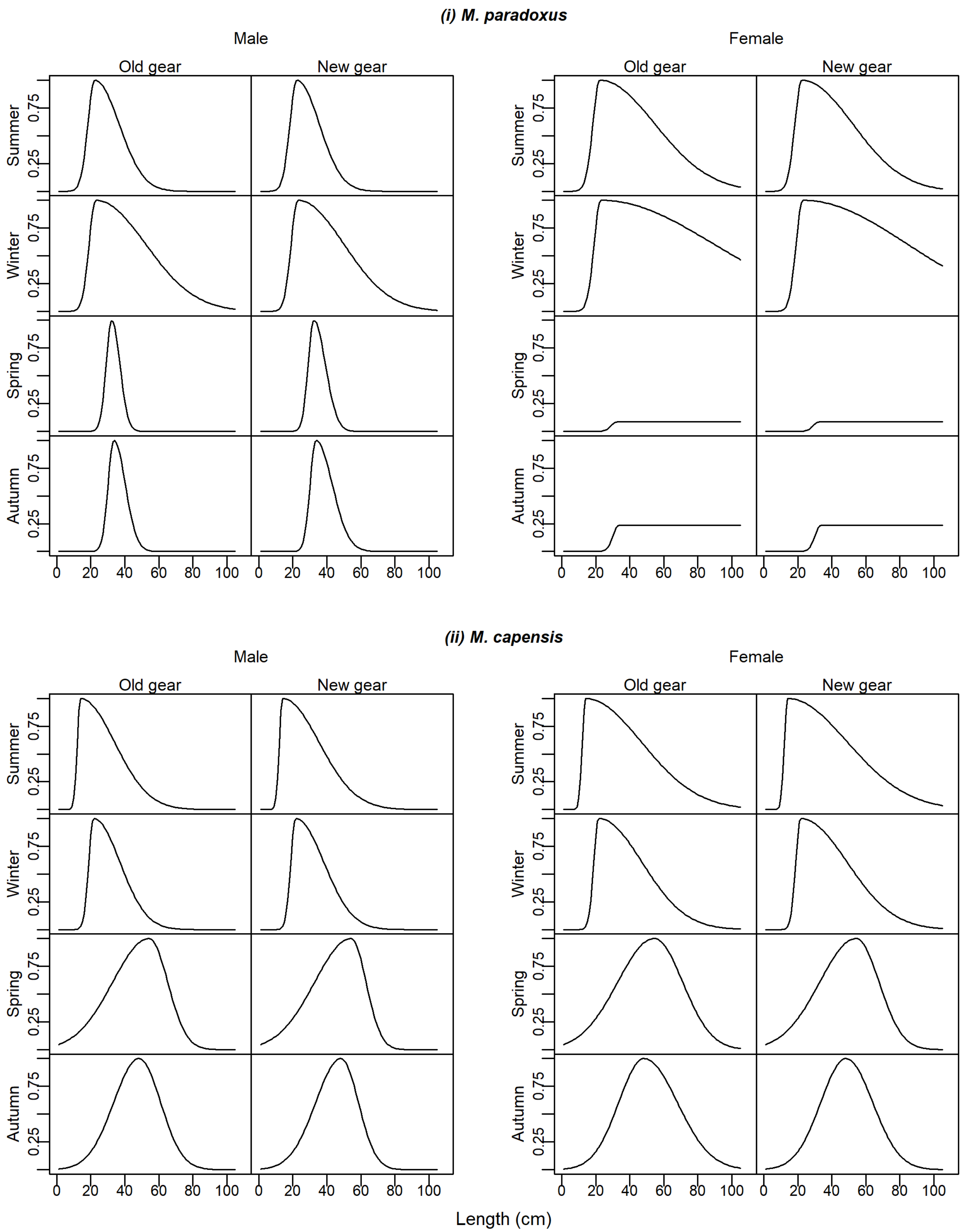

Figure B4: Commercial selectivities-at-length for the Reference Case.

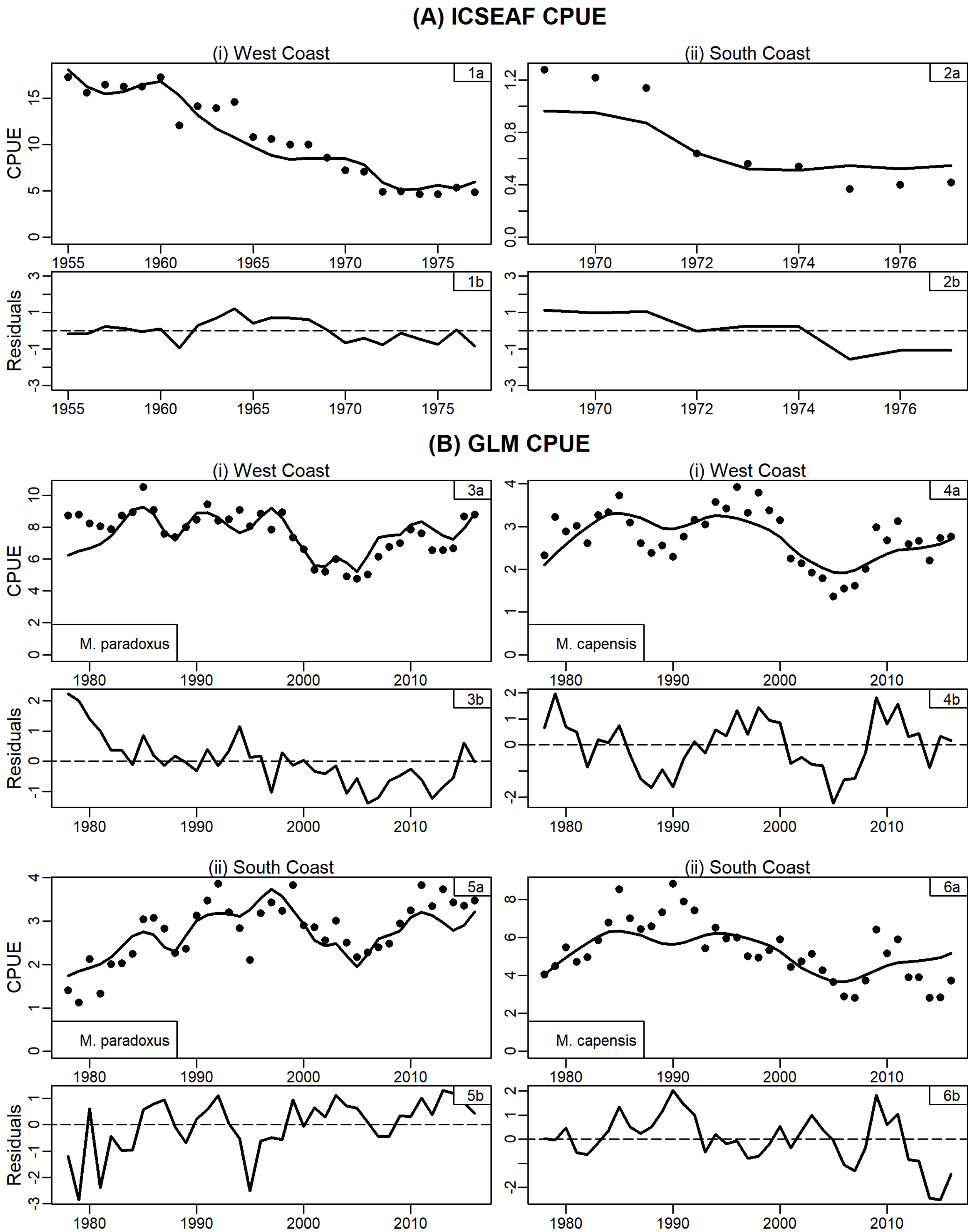

Figure B5: Fits to the CPUE series, with standardized residuals, for the Reference Case.

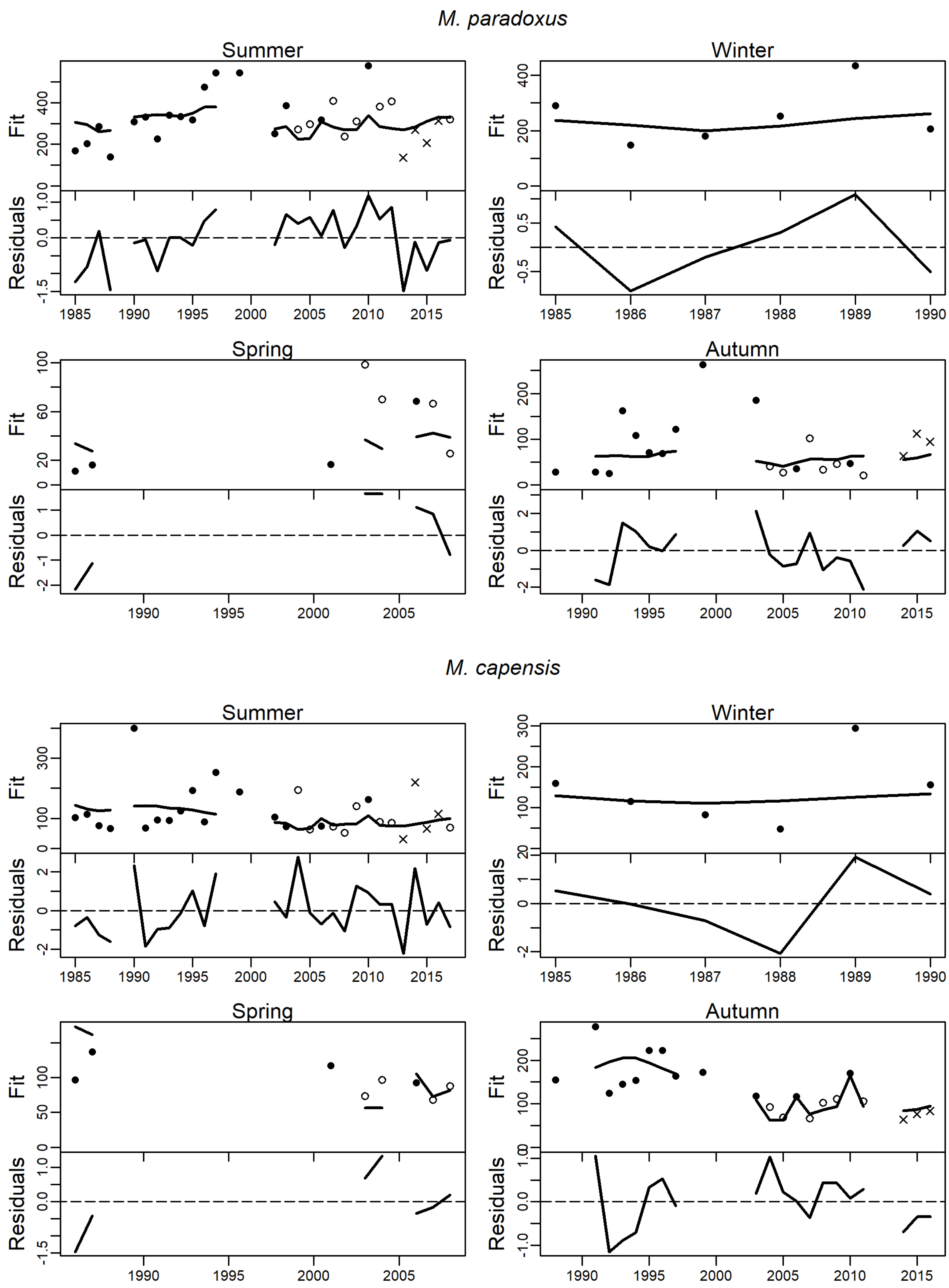

Figure B6: Fits to the survey series for the Reference Case. The full circles show the surveys conducted by the *Africana* old gear (adjusted by the Africana old/new gear calibration ratio), the open circles by the *Africana* new gear and crosses by industry vessels.

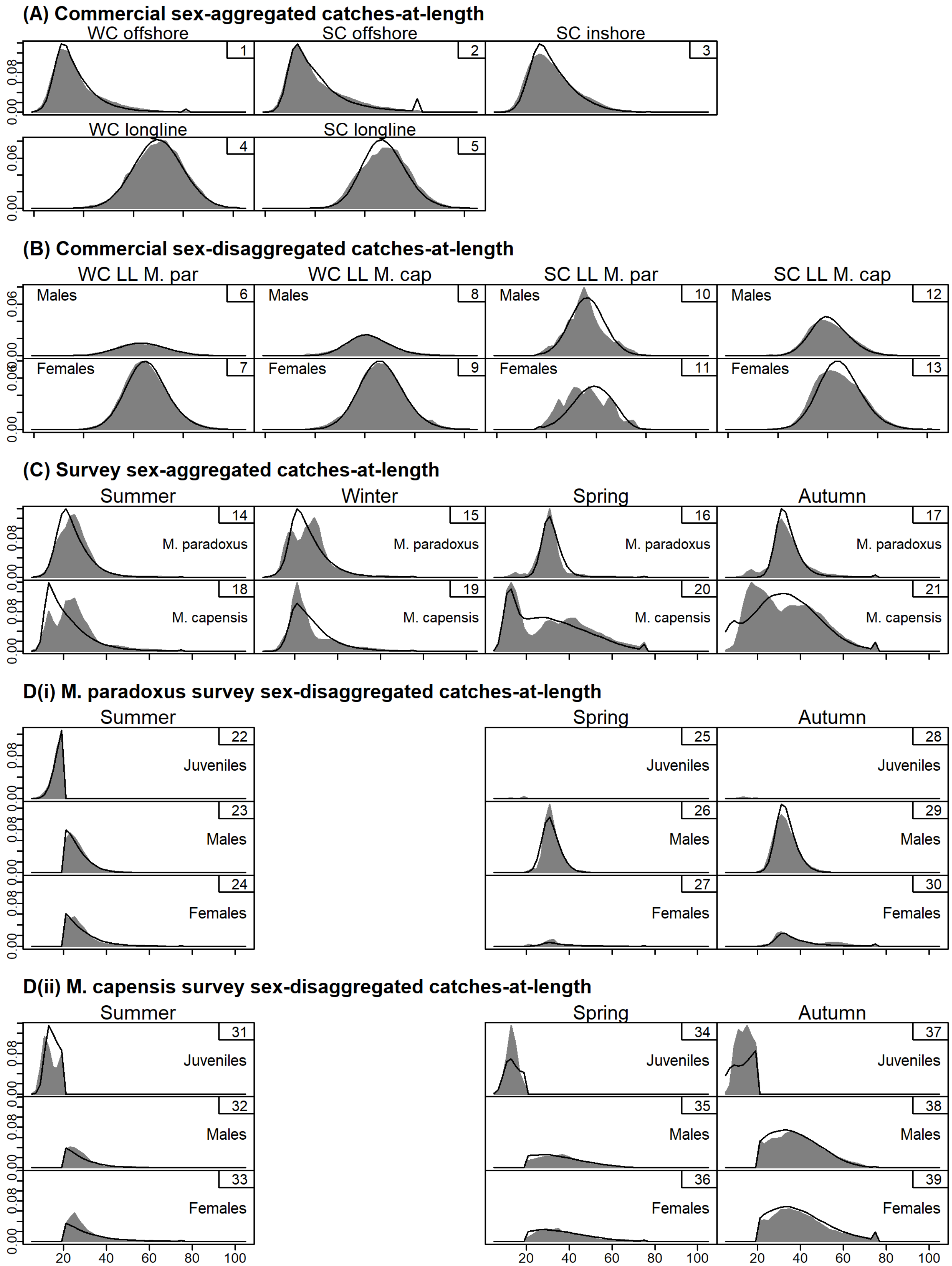

Figure B7: Fits to the commercial and survey catches-at-length averaged over years for the Reference Case.

Appendix B: Hybrid method for determining the fishing mortality rates when the Baranaov formulation for the catch equation is implemented

The use of Pope's approximation for catches carries with it the problem that catches may exceed model predicted population sizes. In ADMB, the *posfun* function may be utilised to prevent the population from going negative, but this may also create difficulties in the minimisation process owing to the high penalties that often arise from use of the *posfun* function. An alternative is to implement the Baranov catch formulation, since under that formulation $N_{y+1,a+1} = N_{y,a}e^{-(M_a+\sum_f S_{fya}F_{fy})}$, i.e. $N_{y+1,a+1} > 0$ at all times. In the Baranov catch formulation, the model-predicted catches are given by:

$$C^{mod} = \sum_a F_{fy}S_{fya}N_{ya}w_a \frac{1-e^{-(M_a+\sum_f S_{fya}F_{fy})}}{M_a+\sum_f S_{fya}F_{fy}}$$

Since we cannot solve for the fishing mortalities *F* explicitly, they could be treated as estimable parameters or solved using a Newton-Raphson algorithm with a fixed number of iterations. The former approach increases the number of estimable parameters substantially, while the latter approach is straightforward to implement only when there is a single fishing fleet, but for several fleets a Newton-Raphson approach for several variables would quickly become very complicated. Below is a description of the "Hyrbid method" (Andre Punt, *pers. comm.*) which can be used to solve for *F* when there are multiple fleets. Subscripts for year, species *etc* have been left off in the interest of clarity and would need to be added in practice.

Step 1: Initial guess

Let $\tilde{F}_f^1$ be an initial guess for F_f:

$$\tilde{F}_f^1 = C_f^{obs} \Big/ \left(\sum_a N_a S_{fa} w_a + C_f^{obs}\right) \qquad \text{(C1)}$$

The actual starting estimate for F_f is derived from $\tilde{F}_f^1$ as follows:

$$F_f^1 = -\ln\left(1-\left[\tilde{F}_f^1\left(\frac{1}{1+\exp\left(30\left(\tilde{F}_f^1-v\right)\right)}\right)+v\left(1-\frac{1}{1+\exp\left(30\left(\tilde{F}_f^1-v\right)\right)}\right)\right]\right) \qquad \text{(C2)}$$

This formulation serves to put an upper limit on *F*. The choice of *v* determines this upper limit, since as $\tilde{F}_f^1 \to \infty$, $F_f^1 \to -ln(1-v)$. For the RC a value of 0.95, corresponding to an upper limit of 3 on *F* was used, although this upper limit was never reached.

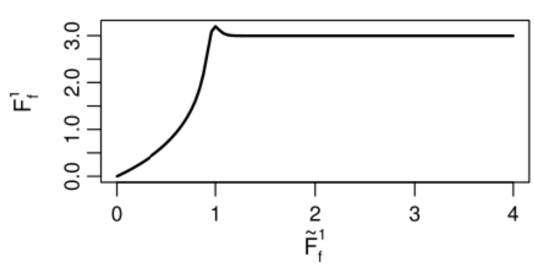

Figure C1: Starting estimate F_f^1 as a function of $\tilde{F}_f^1$.

Step 2: Compute the model-predicted catches given F_f^i and M_a

Let $Z_a^i = M_a + \sum_f F_f^i S_{fa}$. Then the model-predicted catches are given by:

$$C_f^{mod} = \sum_a F_f^i S_{fa} N_a w_a \frac{1 - e^{-Z_a^i}}{Z_a^i} \tag{C3}$$

Step 3: Compute an adjustment factor, and adjust *Z*

An adjustment factor A^i is computed so that if the model-predicted catches are too small ($C^{obs} > C^{mod}$), then $A^i > 1$, and if they are too big, $A^i < 1$.

$$A^i = \left(\sum_f C_f^{obs}\right) / \left(\sum_f C_f^{mod}\right) \tag{C4}$$

The *F* component of the mortality is then scaled accordingly:

$$Z_a^i = M_a + \sum_f (A^i F_f^i) S_{fa} \tag{C5}$$

Step 4: Find F_f^{i+1} for next iteration

The next estimate for F_f is given by:

$$\tilde{F}_f^{i+1} = C_f^{obs} / \left(\sum_a S_{fa} N_a w_a \frac{1 - e^{-Z_a^i}}{Z_a^i}\right) \tag{C6}$$

Note the congruence between Equation C6 and Equation C3 with F_f^i as the subject of the formula.

To obtain the next iterative value for *F*, the following formulation is used so that there is an upper limit on *F*:

$$F_f^{i+1} = \tilde{F}_f^{i+1}\left(\frac{1}{1 + \exp\left(30\left(\tilde{F}_f^{i+1} - 0.95F_{max}\right)\right)}\right) + F_{max}\left(1 - \frac{1}{1 + \exp\left(30\left(\tilde{F}_f^{i+1} - 0.95F_{max}\right)\right)}\right) \tag{C7}$$

In other words when $\tilde{F}_f^{i+1} < 0.95F^{max}$, F_f^{i+1} has a near to linear (1:1) relationship with $\tilde{F}_f^{i+1}$. As $\tilde{F}_f^{i+1}$ approaches $0.95F^{max}$, the F^{max} contribution in Equation C7 starts to dominate and $F_f^{i+1} \rightarrow F^{max}$. For the RC, F^{max} was set to 2.

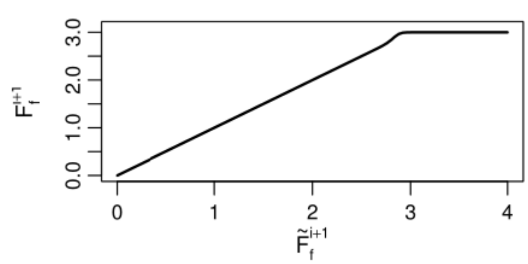

Figure 2: F_f^{i+1} as a function of $\tilde{F}_f^{i+1}$ in the iterative process

Step 5: Last iteration

Step 2 - Step 4 are repeated until the last iteration is reached (e.g. iteration 5). At the last iteration, Step 2 - Step 4 are not followed, and instead the model-predicted catch and mid-year biomass are computed based on the final *F* obtained.